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EDITOR'S NOTE

INSA is committed to the growth of natural knowledge in India and its application to the problems of national welfare. Being the adhering body in India for the ICSU, the Academy is entrusted with deputing Indian delegations to various international conferences and symposia. Since its inception in 1935, INSA has endeavoured to promote the dissemination of scientific knowledge and matters concerning science policy and philosophy of science. The Fellows of the Academy have played a major role not only in practising science but in actively participating in professional meetings the world over.

Realizing that the three scientific journals being published by the Academy are primarily devoted to the communication of scientific research findings, a new quarterly journal has been started to cover international science news and present delegation reports to the Fellowship and to the Indian scientific community at large. The contents of the journal cover: *(i)* reports of General Assembly meetings of ICSU and other organizations; *(ii)* reports of INSA delegations sent abroad; *(iii)* brief accounts of individual scientists sponsored by INSA to attend conferences; *(iv)* highlights of international conferences in specialized areas of research; *(v)* experiences of scientists under Inter-Academy exchange programme; *(vi)* summaries of lectures delivered by distinguished scientists and *(vii)* excerpts of news-worthy items from leading international scientific journals.

Through this publication, the Academy aims to spread current developments in scientific knowledge and to ascertain view on values and judgements in science and technology.

It has been three years now since the idea of publishing the delegation reports was first conceived. We have been receiving objective reports of the delegates sponsored to various international conferences and symposia. Apart from reporting to the Academy about their individual contributions to a given conference, the delegates are expected to focus attention on its main theme as well as highlight the major conclusions for the benefit of the wider community. This will provide an overall picture of the conference to the interested reader and thus help in meeting the basic obligations of the journal.

The number of write-ups received by us in last three years were much more than could possibly have been included in this journal. In order to cover the maximum number of conferences/symposia, some of these reports are being included as short communications, and more such items are envisaged in the forthcoming issues. We also look forward to suggestions for improving the contents and scope of this journal.

A N Mitra

XI INTERNATIONAL PLANSEE SEMINAR' 85 NEW APPLICATIONS, RECYCLING AND TECHNOLOGY OF REFRACTORY METALS AND HARD METERIALS*

The XI International Plansee Seminar took place in the Walter Schwarzkopf House of Metallwerk Plansee GmbH in Reutte, Austria. The conference was in English, German and French and simultaneous translation was provided for oral presentations. Registration and participation required a personal invitation.

Ever since the first Plansee Seminar in 1952, progress in the powder metallurgy of refractory meals and hard materials has been the central theme of these meetings, organized once in 4 years. This traditional pattern has been maintained and contributes to the special character of this international PM-conference.

The XI International Plansee Seminar '85 covered 'New Applications, Recycling and Technology of Refractory Metals and Hard Materials' during May 20th to 24th 1985 at Reutte, Tirol, Austria. About 160 papers were presented, two thirds of which were in the poster presentation. Display directly at the conference site in the Walter Schwarzkopf House, the opening of poster presentations by introductory lectures and special sessions during which no oral presentations took place, emphasized the importance of visual presentations.

During registration, well before the seminar two, Proceedings volumes containing 128 full papers were given. The I volume contains 64 papers with a total of 972 manuscript pages and the II volume contains also 64 papers with a total of 1035 pages. The III volome, yet to be published may contain some belated papers and discussions. The papers were grouped in three main domains-Refractory Metals, Coatings and Hard Meterials. The refractory metals papers included Mo and their alloys, W and its alloys, Non-sag tungsten, Ta, Nb and their alloys, PM-Superconducting materials, Ti and Zr and their alloys. Coating procedures for and by refractory metals and hard

*Based on the delegation report of Professor R Mallikarjunan, Department of Metallurgical Engineering, IIT, Bombay.

materials included coating by PVD processes, coating by plasma spraying and other coating procedures, coating by CVD processes and properties and testing methods of coatings. The hard metals and hard meterials included hard metal recycling, hard metal substitutes, hard meterials, properties and test methods of hard metals. About 600 delegates participated from about 30 countries. There were 28 papers from Federal Republic of Germany, 24 from Austria, 11 from USA, 11 from UK, 10 from China, 9 from USSR, 8 each from France and Japan and 6 papers from India.

After the opening ceremony and welcoming addresses, Professor Hellmut Fischmeister, Director of the Institute of Materials Sciences at the Max Planck Institute of Metal Research in Stuttgart was awarded the 1985 Plansee Medallion for his outstanding contributions to scientific principles and technological applications of powder metallurgy of ferrous products, refractory metals, hard meterials and hard metals.

In addition to poster presentations, a few papers were presented orally—in four sessions for refractory metals, 3 sessions for hard metals and meterials and one session each for coating by PVT procedures and coating by CVD processes and by plasma spraying. One session was devoted to the workshop on First Wall Materials for Fusion Reactors.

Session on Refractory Metals

Professor R M German of Rensselaer Polytechnic Institute, Troy, New York presented an excellent paper on the 'Microstructure Limitations of High Tungsten Content of Heavy Alloys'· Heavy alloys are tungsten based compositions which relay on Ni and Fe additions to form a liquid phase during sintering. The resulting materials is a two phase composite composed of dispersed tungsten grains in an alloy matrix. Ni to Fe ratio of 7:3 has been found to be optimal in these alloys since this avoids the formation of intermetallic phases. The paper focuses on the density, strength and ductility variations at high concentrations of W (90-99.5%). Fundamental relations between properties, processing and microstructure are developed versus W content. At high W levels, strength and ductility decrease because of a rapid rise in contiguity. High W content heavy alloys are susceptible to impurity segregation to the W-matrix interface. Consequently mechanical behaviour is sensitive to processing conditions. Higher properties are possible by altering the dihedral angle and tungsten matrix interfacial energy through minor alloying additions.

C Langee and others from France reported their work on 'Densification and Microstructural Development of LPS W-Ni-Cr Heavy Alloys'. LPS of pure W grains embedded in a binder phase based on Ni or Cu has been extensively reported in

literature, but few works were devoted to materials that involve one element dissolving in the W grains as well as Ni base binder. They examined such an element-Cr-on the densification and microstructural development of W-Ni LPS. The ternary alloys consist of W-Cr grains embedded in Ni-Cr-W binder. Their maximum densification is obtained from LPS temperatures providing the complete melting of the ternary binder. The experimental size distributions suggest that coalescence participates to the grain growth of Ni-W and W-Ni-Cr alloys. The increase of growth rate produced by the increase of solid fraction involved during sintering indicates that the transfer rate of the constitutive elements of the solid phase is governed by diffusion. Professor G S Upadhyaya of IIT Kanpur pointed out that there will be problems in mechanical properties if the diffusivity of Cr in Ni is more.

J B Lambert, P F Ziegler and J J Rausch of Fansteel Inc., USA reported a new material for environments involving wear and corrosion-TRIBOCOR 532 N-having the composition Nb-30Ti-20W which is produced by the conventional melting techniques for refractory metal alloys. The cast alloy is highly fabricable. Surface nitriding of the finished shape produces a structure of coherent, hard nitrided phases dispersed in a refractory metal alloy matrix analogous to cemented carbrides. The hardness gradient from surface to core metal can be varied over wide limits with different nitriding treatments. The corrosion resistance is outstanding in a number of different corrosive media. When questioned about the behaviour of TRIBOCOR in aggressive gases, the authors replied that more expeeriments are required to answer the question. The base alloy itself is quite corrosion resistant and nitriding markedly improved the propeties.

Recycling of titanium and titanium alloys was reported by B L Mordike and W Luft, Technische Universitat Clausthal, West Germany. The aim of their work was the development of a technique of recycling high value scrap which avoided costly remelting and which was economic and environmentally acceptable. The various types of scrap is first chopped to manageable size, degreased and compressed to billets, to 70% theoretical density in a steel can which is subsequently sealed. The billet is extruded, can be removed and annealied for further production of screws and nuts with required specifications. The delegate pointed out that the procedure is bound to increase the impurity pick up, particularly interestitial impurities and the reduction of interstitial impurities will not be possible, a major consideration in titanium recycling. The authors have not given any consideration to impurity levels.

C K Gupta et al from BARC, Bombay authored a paper on the 'Reclamation of Molybdenum Powder from its Scrap' by a combination of hydro and pyrometallurgical technique. The process consisted of leaching the scrap in HNO_3 in the presence of small amount of H_2SO_4 to generate Mo bearing solution and recovery of either pure ammonium salt of Mo by addition of ammonia or molybdic acid by simple thermal

treatment. The precipitated salts were calcined and subjected to hydrogen reduction in two stages to yield Mo metal.

The paper entitled 'Formation of Tungsten Blue Oxide and its Hydrogen Reduction' by Zow Zhiqiang from China P/M Research Institute was presented as a poster. Distinct from WO_3, the composition and the phase constitution of commercial TBO is changeable, including different compounds. The paper presented the formation of TBO and its H_2 reduction. By means of *in-sttu* high temperature x-ray diffraction quantitive phase analysis, the phase transformation process and the dynamics of TBO during H_2 reduction was studied. The phase transformation process of TBO during H_2 reduction is different from that of WO_3. It should be better to use the TBO based on ATB- ammonium tungsten bronze. At low temperatures (600-700°C) the H_2 reduction activity of ATB is higher than that of WO_3.

'The Production of Refractory Metal Nitrides and Some New Observations in the Titanium-Nitrogen System' was one of the interesting poster presentation by L R Wolf and others from Holland. They describe the production of a number of refractory metal nitrides, using the Reactive Arc Melting technique. Subsequent annealing at 1400-2000°C under N_2 yielded homogeneous, massive specimens of TiN, VN, ZrN, HfN. Cr and Ta led to the formation if subnitrides Cr_2N and Ta_2N and Nb yielded Nb_4N_3 phase.

The Ti-N phase digram has been subjected to new investigation. Preliminary results indicate that TiN composition range exhibits a sudden narrowing towards compositions richer in N_2 at temperature below 1400°C. At higher temperature thc Ti rich limit corresponds to 28.5-29 atomic % N, while below 1000°C 36.5 atomic % N is found. The homogeneity region of Ti_3N phase was found to be larger than supposed so far: At 900-1000°C Ti_2N can exist between 28.5 and 33.7 atomic % N.

Lu Da Ming of the Central Iron and Steel Research Institute, China presented his paper on 'The New Applications of Refractory Metals and Alloys in China'. China is noted for its refractory metals resource; especially · tungsten. High temperature materials; hot working tool and die materials, electric contacts, heavy alloys, elastic alloys and expansion alloys, anticorrosion materials and electronic materials are included.

G S Upadhyaya from IIT Kanpur presented the poster on 'Effect of Binder Composition and Sintering Period on the Properties of W-Fe Ni Heavy Alloys. They studied the sintering behaviour of 90 W/ 10 Fe-Ni heavy alloys with respect to the binder composition and sintering time. Sintering was performed at 1500°C in dry H_2 for 2 hours. Their results reveal best mechanical properties in case of binder corresponding to 20Fe/80Ni. Heavy alloys with different binder compositions exhibit enhanced densification with higher Ni in the binders and longer sintering period.

B Lux and others from Technical University of Vienna, Austria presented the poster on 'The Reduction to Tungsten'. They investigated the different reduction steps occuring during the reduction of tungsten oxide by hydrogen and described changes in morphology during that formation of $WO_{2.72}$ and WO_2 as well as W. Nucleation and growth resulting from the local reduction condition determine the morphology.

The poster by Zhao Quinshang and other from China discussed the 'Carbothermic Reduction of Tantalum Oxide-A Still Effective Method for Production of Capacitor Grade Tantalum Powder'. Two stage direct reduction is described. The influence of reduction temperature Ta_2O_5 modification, particle size of graphite powder, oxygen excess in burden, vacuum and other factors on carbothermic reduction and purification effect of sinter refining have been considered and product quality listed. The Ta powder produced by this method has good stability of properties, wide capacitance distribution (500-8000 u F. V/g), wide range of working voltage for dry electrolytic capacitors (6.3-125 V), high metal recovery (93.38%), simplicity of processing, low production cost and low pollution of the environment.

An excellent paper on the 'Progress in the Economical Production of Very Clean Refractory Metals and Alloys by Electron Beam Melting' was presented by H Stumpp, Leybold-Heraeus GmbH, West Germany. Important progress was achieved by the computerization of all process controls. Refining of the refractory materials up to extreme cleanliness became possible by a sequence of eb-proccsses like eb-drip melting, eb-zone refining and crucible free ingot melting. Nb, Mo, W with a few ppm interstitial elements and ppb range of trace elements can be produced effectively by eb-drip melting process which can be followed by eb-floating zone melting. Recent improvements of eb-melting furnaces were discussed. The discussion that followed questioned the analytical procedures adopted.

Session on coating procedures and properties of coatings

The interesting paper entitled 'On Properties of Magnetron Sputtered Wear Resistant Chromium and Chromium Nitride Films' was presented by O Knotek from West Germany. With magnetron sputtering, which counts like ion plating as a PVD technique, many compositions can easily be deposited with high rates. Varying the dominant process parameters like pressure ratio, power, substrate bias and temperature, CrN_x films were deposited on cemented carbides and high speed steels. The phases Cr, Cr_2N and CrN could be created reproducibly by varying the reactive gas content with high deposition rates. Scratch tests underline the good adhesion of the films. The films work against wear in the field of abrasion and adhesion.

G Dearnaley and others, Harwell Laboratory, England presented the paper on 'The Microhardness of Nitrogen Ion Implanted Cobalt Cemented Tungsten Carbide'.

They examined the evidence regarding the strengthening mechanism brought about by ion implantation and to explore particularly the modification of the binder phase. The microhardness of various grades of cobalt cemented tungsten carbide offer ion implantation with nitrogen at 300-500°C showed an increase. It is inferred that the hardening mechanism occur predominantly in the binder phase. It is suggested that interstitial nitrogen, which dissolves more freely in fcc structure, provides a more effective pinning of dislocations during a strain hardening process than it does in the hcp binder alloy.

D T Quinto from USA presented the paper 'High Temperature Microhardness Profiles of Hard CVD Coatings'. Using the ball wear scar technique, microhardness profiles across the thickness of CVD coatings and the substrate are measured from room temperature to 1000°C. They presented data for single and multilayered coatings of TiC, TiCN, TiN and Al_2O_3 on commercial carbide tools and discussed wear mechanisms in coated tools. Abrasive wear protection is afforded by hard coatings at lower effective temperatures, but as the relative hardness between coating and substrate materials equalize (or even reverse) at high temperatures, the chemical wear protection mechanism is more significant. Al_2O_3 is uniquely suited for greater wear protection in high speed machining of ferrous metal due to its combined chemical inertness and high microhardness at 1000°C.

The interesting paper on 'Plasma Sprayed Coatings of Refractory Metals as Wear Protection for Piston Rings' was presented by H J Newhawser of FRG. He examines the influence of the type and grain size of the powder on certain coating parameters as examplified by metallic and cermet coatings on a Mo base and on oxide-ceramic multicomponent coating. It is shown that in the case of multicomponent plasma spray coatings the cohesion is governed essentially by the configuration in which the individual components are present in the powder used.

O Knotek and others from FRG presented his poster on 'Wear Resistant Sputtered Films Based on the System Ti-Al-C-N-O'. In addition to CVD techniques for wear protection, there has been increasing use of PVD techniques. One particularly promising technique is magnetron sputtering because of the comparatively high deposition rates achieved. Complex coatings-$TiAl_XN$ and Al_2O_3 with little additions of nitrogen or titanium, stabilize the amorphous structure upto 1000°C. The $TiAl_XN$ phases show better wear resistance than TiN and Ti (C, N) with further advantage of higher deposition rates.

'Wear Resistant Coatings by Brazing of Hard Metal Powders to Surfaces' was presented by A Szwlczyk and others from Degussa, FRG. Based on tungsten carbide, tungsten carbide/cobalt powders and Ni base brazing alloys either wear resistant coatings or surfaces for abrasive tools can be produced. They evaluated the quality of the layers, their hardness and wear properties.

PPJ Ramaekers and LR Wolff from the Netherlands presented the interesting poster on 'Production of a SiC-C-W Hot Shell by CVD'. Combustion Heated Thermionic Energy Converters (TEC' S) need a 'hot shell' in order to protect them from combustion environment. SiC is selected for this. Tungsten is used as an emitter material for TEC'S. As W reacts with SiC, forming a brittle W_5Si_3 as well as WC and W_2C, an intermediate layer of graphite is used to prevent W_5Si_3 formation. The hot shell is produced by coating a graphite form on the outside with SiC by means of CVD. On the inside it is coated with W also by CVD.

'Ultramicromeasurements of Hardness on Sputtered Hard Material Layers' presented by HA Jehan, FRG discusses the measurements of ultramicrohardness of some nitride coatings by means of a commercial hardness tester which enables the observation in a SEM. This metrod allows the determination of the true layer hardness.

W Schintlmeister and others presented 'Production of CVD-SiC Coatings at Medium Coating Temperatures' by pyrolysis of methyl trichlorsilan in the temperature range 900-1200°C on graphite and cemented carbide as substrates. They studied the influence of composition and concentration of the coating gas, temperature on the composition, structure and deposition rate of the coating.

There is an interesting paper on 'Flexible Automation for Atomospheric Plasma Spray Processes' by PJ Meyer, USA, using the articulated robot which allows the greatest variety of motions and areas.

Session on Hard Metals and Hard Materials

P Samuelson and others from Sandvik Hard Materials, Sweden discussed 'A Method of Determining the Strength of Powder Agglomerates' with a microcomputer controlled apparatus for uniaxial tests of spherical granules of diameters around 125 microns. The equipment is used to test spray dried hard metal and ceramics agglomerates by continually registering load and displacement uptil the occurrence of failure. They have reported some preliminary results on the influence of binder/lubricant composition and content, grain size, chemical composition, agglomerate size and humidity on the granular strength of hard metals powder agglomerates.

An excellent paper 'On the Role of Atmosphere and Impurities During Sintering of Cemented Carbides' by B Uhrenius and others from Sandvik Hard Materials, Sweden covered the thermodynamic calculations made on the Ca-Al-Si-S-O-C system at 1400°C. The evaluations were facilitated by using a computer programme for phase diagram calculations of multicomponent systems. The stability regions for the individual sulphides, oxides and silicates are plotted as a function of the sulphur and oxygen potentials at conditions close to sintering of cemented carbides. Two diagrams are presented—one where maximum activities of elements correspond to carbide saturation and

a second for reduced activities of the elements Ca, Si, and Al corresponding to an assumed trace element level in liquid Co.

T A Hack and C T Peters from Boart Research Centre, South Africa presented a 'Model for the Wear Behaviour of Hard Metal Rock Bit Inserts in Percussive Drilling', which accounts for the observed differences in wear rates among the grades tested and explains the relationship between wear mechanisms and mechanical properties. The critical property controlling wear appears to be fracture toughness.

J J Oakes from Teledyne Firth Sterling, USA discussed the 'Effect of Cr and Mo additions to the Binder Phase of Cemented Carbides Used for Rod Mill Rolls'. Cr levels of about 5% are needed to significantly improve the oxidation resistance of cemented carbide in air between 700-1000°C. Mo additions reduced the oxidation resistance imparted by Cr. This led to the selection of Co-Ni-Cr bonded material for tests in rolling service which outperformed the Co bonded grades. The importance of oxidation and corrosion resistance imparted by Cr to the roll was demonstrated.

A Hara and others from Sumitomo Electric Industries, Japan, presented 'Thermodynamic Evaluations of Equilibrium Nitrogen Pressure and WC Separation in Ti-W-C-N System carbonitride'.

The paper on 'Cobalt Substitution in Technical Hard Metals' was presented by H Grewe, Krupp GmbH, FRG. The usual Co rich binder phase is replaced by binder phases of the ternary system Fe-Co-Ni, the binary system Co-Ni and also by Fe-Ni.

C T Peters and S M Brabyn from South Africa presented the paper on the 'Properties of Ni Substituted Hard Metals and their Performance in Hard Rock Drill Bits'. A WC-7Co-3Ni hard metal was found to perform equally as a conventional WC-10Co grade in hard rock drilling. The drilling performance supports the hypothesis that hard metal fracture toughness is more important than other mechanical properties such as hardness, in determining rock bit insert wear behaviour. This suggests possibility of complete substitution of Ni for Co.

J A Cave from England presented the paper 'Superalloy Bonded Hard Metal' Superalloys are a class of material well known for strength and temperature. He examined if the steel machining properties of hard metal could be improved by replacing the Co binder phase with one of the superalloy composition. The superalloy grade showed substantially improved life over conventional material.

H Nowotny of University of Vienna, Austria presented the paper 'Silicon Nitride and Transition Metals : A Critical Evaluation of Existing Phase Diagram Data Supplemented by New Experimental Results'.

H Holleck, Nuclear Research Centre, Karlsrühe, FRG investigated the 'Highly Wear Resistant, Binder Free Carbide Boride Materials'. TiC/TiB_2 materials exceed in wear resistence most of the ceramic tool materials.

Surjit Singh and P Ramakrishnan, IIT-Bombay discussed in their paper the 'Development and Evaluation of a New Micrograin Hard Metal', by cementing the tungsten carbide particles with a modified Co-P bonding alloy. The use of the modified binder has reduced the sintering temperature from 1400°C for WC-Co alloy to 1275°C for the new material and improved the cutting performance on En-9 steel and increased the tool life.

K Vadasdi and others from Hungary described the 'Hydrometallurgical Recovery of Valuable Metals from Cemented Carbide Scraps'. The process is based on the anodic oxidation of scraps in alkali carbonate solutions in an electrolytic cell and the valuable metals W, Ta/Nb and Co are separated and recovered in the form of metal salts or oxides, The liquid contains sodium tungstate and can be processed to APT or tungstic acid. The separated solid phase containing Co, Ta/Nb/, Ti and some W is leached with HCl for dissolution of Co, then precipitated, as an oxalate. Solid residue is dissolved in HF and recovered with THP extraction

Roy Cooper and others from SA present 'A Model for the Evolution of Graded Microstructures and Properties in Hard Metal Composites consolidated by Sinter Bonding'.

Workshop on 'Choice of Materials for the First Wall Conception of Fusion Reactors

Dr Hubertus Nickel, Director, Institute for Reactor Materials, Technical University Aachen, West Germany presented the paper on 'Plasma Wall Interaction in Fusion Reactors and its Effects on First wall Materials. The Materials used so far for the first wall are in most cases stainless steels or Fe and Ni base alloys. For limiters, Fe and Ni base alloys or graphites are used. Generally SiC cannot be used as material for high heat-flux components due to their poor thermal shock resistvity. This is not true for SiC + 2% Al nitride. A high temperature resistant material with good thermal conductivity and active cooling could be used. The plasma facing side should be covered by a suitable coating which can be deposited or repaired in-situ or which is thick enough for a sufficiently long operation period and which meets the requirements, probably a CERMET.

3. Recommendations/Conclusions

Dr Paul Schwarzkopf defined the aims of the Plansee Seminars at its very inception as follows.

1. Furtherance of closer cooperation between scientists and engineers.

2. Creation and renewal of personal contacts between powder metallurgists and scientists as well as engineers working in related fields.

3. Exchange of experience among scientific communities working independently in different countries.

It was clear that original aims have been more than achieved through this conference, confirming the necessity of this seminar once in 4 years.

The progress in the powder metallurgy of refractory metals and hard materials has been the central theme. Addition of coating procedures and properties of coatings on and by refractory metals and hard materials is a welcome feature that will be continued in future conferences. Another new topic discussed in the Workshop on 'First wall Materials for Fusion Reactors' deserves continued discussion in future seminars.

4) Major Breakthroughs or Results Reported at the Conference

1. An economical mode of rolling procedure with particularly few necessary processing steps has been developed for manufacturing of pure Mo, Mo-K-Si alloy as well as doped and undoped tungsten material in particular for use in medium output industrial enterprises. Semifinished products manufactured by this rolling technique comply with all requirements of the lamp making industries, welding technologies (e.g. tungsten-lanthanum electrodes) and the manufacture of electric contact component parts. The drawing pass machinery (two high rolling mill including the heating equipment necessary for continuous loading with sinter metal rods can be got with reasonable investment costs). (G Köhlstrung and others, Central Institute of Solid State Physics and Materials research, GDR).

2. Vacuum hot ultrasonic flattening (VHUF) method, patented in several countries, for W and Mo. The method consists in vacuum wire flattening with heating up to the temperature of metal recrystallization. Wire deformation is obtained with ultrasonic instruments from both sides. The paper reports the physicomechanical properties and structure of the flat wires obtained by VHUF (S P Kundas and others, Minsk Radioengineering Institute, USSR).

3. Preparation of APT by means of electrodialysis and solvent extraction - The new method includes an electrodialytic NaOH recovery process from the leached sodium tungstate solution. The isopolytungstate extracted with long chain amines. Minimal consumption of materials and minimal formation of byproducts is accompanied by maximal efficiency and yield of product. Electrodialysis with cation exchange membranes resulted in new, so far unknown isopolytungstate species.

4. TRIBOCOR 532N—A new material for environments involving wear and corrosion TRIBOCOR 532 is an alloy Nb-30Ti-20W produced by conventional melting

techniques. Surface nitriding of the finished shape produces a structure of coherent, hard nitrided phases dispersed in a refractory metal alloy matrix—TRIBOCOR 532N. Optimum combination of wear or abrasion resistance versus toughness for a selected application can be produced. Corrosion resistance is outstanding. (L B Lambert and others, Fan Steel Inc., USA).

5. Electrometallurgical process for recycling of zircaloy scrap by molten salt electrolysis, using $NaCl\text{-}K_2\ ZrF_6$ and $NaCl\text{-}NaF\text{-}ZrCl_4$ baths has been developed. The process offers considerable advantages towards the development of a commercial route for recycling zircaloy scrap (J C Sehra, R Mallikarjunan and others IIT Bombay).

6. Temperature probe of W-Re thermocouples for use in steel making over 1750°C has been developed. (Song Lin and others, Iron and Steel Research Institute, China).

7. Development and evaluation of a new micrograin hard metal by cementing the tungsten carbide particles with a modified Co-P bounding alloy was reported. (Surjit Singh and P Ramakrishnan, IIT, Bombay).

8. A hydrometallurgical route has been developed for processing cemented carbide scraps-WC, TaC, NbC, TiC and Co. The process is based on the anodic oxidation of scraps in alkali carbonate solutions. (K Vadasdi and others, Hungary).

9. The recovery of Mo metal powder from scrap by a combination of hydro and pyrometallurgical technique has been reported. The process consisted of leaching the scrap in HNO_3 in the presence of small amounts of H_2SO_4 and recovery of pure molybdenum salt or molybdic acid by simple thermal treatment. The precipitated salts were calcined and subjected to hydrogen reduction to yield Mo metal, (C K Gupta and others, BARC, Bombay).

10. Economical production of very clean refractory metals and alloys by electron beam melting, by the computerization of all process controls has been reported. (H Stumpp and others, West Germany).

11. 2D vision machine for locating and handling of random parts in hard metal technology has been developed.

12 'High strength P/M aluminium alloy after rapid solidification and processing'-deals with structure and mechanical properties of high strength P/M aluminium alloy series 7XXX for demanding applications (J Duszczyk, P Jugenburger, Delft University of Technology, The Netherlands).

13. The most important of all Mo based alloys is TZM-0.5% Ti, 0.08% Zr, 0.01-0.04% C and is a carbide dispersed hardened material. Besides are melting, P/M methods are used to fabricate sheet rod and forged parts. Mechanical properties are presented. (R Eck, J Tinzl, Metallwerk Plansee GmbH, Reutte, Austria).

14. The electrodeposited hard Cr coatings and flame sprayed Mo coatings on piston ring running surface no longer satisfy the increased demand of engine builders for long service life and high loading capability. To meet these requirements, development have led to the production of wear and breakout resistant plasma spray coatings on a metalic, cermet, anc all ceramic material (H J Newhauser, W Germany).

15. The wear behaviour of cemented tungsten carbide hard metals will be improved significantly by implantation of metalloid ions-nitrogen ions gave best results. An example for practical use in the implantation of printed circuit board drills with nitrogen.

16. Recycling of hard metals in China takes care environmental pollution in the sodium nitrate method. Electrochemical dissolution method is developed. (Chao and Miao, Central Iron and Steel Research Institute, China).

17. Co substitution in technical hard metals by binder phases of the ternary system Fe-Co-Ni, the binary system Co-Ni and also Fe-Ni is reported. (H Grewe, J Kolaska, West Germany).

5) Impact of the Seminar on Indian Research

This seminar on New Applications, Recycling and Technology of Refractory Metals and Hard Materials in bound to have a major impact in three areas of research in this country—Refractory Metals, Coating Procedures for and by Refractory Metals and Hard Materials. Much work on these aspects has been carried out at BARC, Space Research Centre, Midhani, IITs and some companies like Sandvik Asia. There is a wealth of information in the Proceedings of this seminar for the research workers in these centres. Coating by PVD processes, CVD processes, plasma spraying etc. will gain more importance. Plasma sprayed coatings of refractory metals for wear protection for piston rings must receive attention in our automobile industry. Magnetron sputtered wear resistant chromium and chromium nitride films and ion implanted cobalt cemented tungsten carbide will receive further attention. Our research on Mo and its alloys, W and its alloys and other refractory metals like Ta, Nb and their alloys should benefit by the papers in these areas. The recycling techniques discussed will be useful in our research. Finally Co substitution in hard metals deserve our attention. Though Fusion Reactors may be far away, we should start thinking about the choice of materials in these Reactors. In this connection the paper by Dr Nickel, FRG, on 'Plasma Wall Interaction in Fusion Reactors and its Effect on First Wall Materials' is important.

VI INTERNATIONAL SYMPOSIUM ON THE BIOLOGY OF ACTINOMYCETES : A REPORT*

Dr Ved Pal Singh attended the VI International Symposium on the Biology of Actinomycetes was organized under the auspices of FEMS and Hungarian Society of Microbiology during August 26-30, 1985. The plenary sessions were held in the following fields : (*a*) Genetics (organised by the help of Professor D A Hopwood, UK), (*b*) Physiology and Biochemistry of primary metabolities (Professor A Szentirmai, Hungary), (*c*) Biosynthesis of secondary metabolites (Professor A Demain, USA), (*d*) Bioche mistry (Professor G Bradley, USA), (*e*) Morphology and ultrastructure (Professor C Hardisson, Spain), (*f*) Taxonomy (Professor M Goodfellow, UK), (*g*) Pathogenicity and immunology (Professor G Pulverar), (*h*) Ecology and Epidemiology (Professor S T Williams, UK) and (*i*) Differentiation (Professor J Ensign, USA).

The opening lecture was given by Professor D A Hopwood of John Innes Institute, Norwich, UK who gave a detailed account of "Cloning and analysis of antibiotic biosynthesis genes in *Streptomyces*" The use of this technique has resulted in the isolation of the linked sets of structural, regulatory and resistance genes for several antibiotics. In at least one case (actinorhodin) the entire set of genes whose products synthesise the antibiotics from the simple primary metabolites has been cloned. Analysis of the cloned genes is beginning to reveal their patterns of transcription. At least for actinorhodin and methylenomycin, some of the genes are cotranscribed as operons. The manipulation of the regulatory sequences allows antibiotic titre to be enhanced. Transfer of groups of actinorhodin genes into strains producing other isochromanequinone antibiotics, has given rise to novel hybrid antibiotics.

According to Professor T Bapu of Japan, there appears to be a regulatory substance (A-factor) coded for by A-factor synthesising gene (afsA) in *Streptomyces* which regulates streptomycin production and spore formation simultaneously.

The sophisticated techniques employed for developing the strains of actinomycetes for the enhanced production of antibiotics are : DNA sequencing, promotor-probe

* Based on the delegation report of Dr Ved Pal Singh, Research Scientist, Department of Botany, University of Delhi, Delhi - 110007.

analysis, S 1 and exonuclease VII mapping, RNA polymerase binding and protection assays, *in vitro* transcription and site directed mutagenesis (M J Bibb, UK). The use of techniques such as efficient transformation R H Baltz *et al.*, USA) and mutagenesis (M Voegtli *et al.*, Switzerland) has been made for the production of large number of antibiotics. Various types of cloning vectors have been constructed by different laboratories (W Wohllenben *et al.*, FRG; J Pigac *et al.*, Yugoslavia; G B Kiss *et al.*, Hungary) which could be used to carry genes from one species to another for antibiotic biosynthesis. Interestingly, the cloning and amplified expression in *Streptomyces lividans* of the exocellular β-lactamase gene of *Streptomyces albus* has been reported by P Dehottay and coworkers of Belgium. As far as the physiological and biochemical parameters of antibiotic production are concerned, the most important thing is the permeability of membranes. This problem has been very well tackled by V G Bulgokava *et al.* of USSR.

Under the taxonomy part, a committee chaired by Professor S T Willi (UK) discussed the "9th Edition of the Burgey's Mannuel of Determinative Bacteriology". In Pathogenicity and immunology, the dreadly diseases such as human actinomycosis, nocardiosis and hypersensitivity pnemonitis caused by *Actinobycillus* (G Pulverer, FRG, *Nocardia* (K P Schaal, FRG; B L Beaman, USA) and *Thermoactinomyes vulgaris* (V P Kurup, USA) were very well discussed in the symposium. The role of actinomycetes such as marine actinomycetes, organic substrate decomposing actinomycetes and rhizoplane actinomycetes was well documented in the symposium session dealing with ecology and epidemiology (S Thucleus, UK; BM Szabo *et al.*, Hungary; L V Kalakoutskii, USSR; Weyland, FRG; D L Crawford, USA). A brief report on the actinomycete scum in sewage treatment plants was presented by H Lemmer of FRG. He emphasised that in most cases the scum production is caused by high biomass of different nocardioform actinomycetes in the activated sludge. High biomass production is dependent on their supply with relatively high substrate concentrations. Scum actinomycetes have this possibility by living saprophytically on hydrophobic sewage ingredients and by selective supply with easily degradable substrates which are supported by the presence of detergents.

Among the recent developments in the biology of actinomycetes are the production of biparental features in micromonospora recombinants by protoplast fusion (M Frank and M Jarai, Hungary), fusion of heat or UV-inactivated protoplasts of *Streptomyces* (L I Huan-Low *et al.*, China), mapping of *Streptomyces* chromosome by protoplast fusion (M E Podgorskaya and B P Matselynkh, USSR) and interaction of genomes after protoplast fusion of streptomycetes (A A Shevchenko and B P Matselynkh, USSR). The digestion of unusual materials such as chicken feather by keratinase enzyme of an unidentified strain of actinomycete has been reported for the first time by A Benedek *et al.* (Hungary). The studies have also been carried out in which the hydrolytic enzymes such as phosphatases (V P Singh, India), special carbohydrase from

Thermoactinomyces vulgaris (P Klingenberge *et al.*, DDR), cellulase and hemicellulase from *Streptomyces lividans* (D Kluepfel *et al.*, Canada), histidase from *S. coelicolor* (T A Kroning and E K Kendrick, USA) and extracellular proteases from actinomycete strains (Lj Vitale *et al.*, Yugoslavia; J S Bond and S G Bradley, USA) have been characterised. The delgate's paper entitled 'Partial Purification and Charcterization of Phosphatase II from a thermophilic Actinomycete *Thermoactinomyces vulgaris*" concerned the purification scheme suggest that as compared to purification of phosphatases from other microorganisms, the choice of a suitable procedure for purifying one (Phosphatase II) of the three phosphatases of *Thermoactinomyces vulgaris* is unusually difficult. Chromatography on Ion Exchanger (DEAE-cellulose), or a Molecular Sieve (Sehadex G-200) and stepwise elution of the enzyme from hydroxyapatite matrix generally suffers from low recovery (about 9% with 4 fold purification). There are three isoenzymes of phosphatases in *T. vulgaris*. Only two (Phosphatase I & II) of the isoenzymes appear in the polyacrylamide gels after electrophoresis from the pooled fraction of the peak activity after Sephadex G-200 gel filtration chromatography. One of these two isoenzymes (Phosphatase II) is active at both acid and alkaline pH. Only one activity band (Ph-II) is observed in the pooled fraction after hydroxyapatite stepwise elution. It could not be ascertained during the present investigation if the disappearance of alkaline phosphatase I (Ph-I) after ion-exchange chromatography on DEAE-cellulose and of the alkaline phosphatase III (Ph-III) after stepwise elution from the hydroxyapatite column is due to the nonspecific salt precipitation of Ph-I in the former case and due to hydroxyapatite matrixdependent inactivation of Phosphatases III in the later as Ca^{2+}, a part of the matrix, inhibits *T. vulgaris* phosphatases) or due to the removal or elimination of these species during respective purification steps.

The existence of various other non-phosphatase proteins in the partially purified preparations, as revealed by polyacrylamide gel electrophoresis, suggests that they can be separated in an electric field. It appears that Ph-II falls within the range of the capacity of ion exchanger (DEAE-cellulose) to retain various other nonspecific proteins and also within the range of molecular weights covered by a variety of nonspecific proteins. The pH optima of the partially purified Ph-II of *T. vulgaris* are exactly similar to those observed for acid (pH 6.0) and alkaline (pH 9.5) phosphatases in the crude extracts in both acid and alkaline range. Similarly, the temperature optima at both acid and alkaline pH are not affected after purification, except that at acid pH the purified preparation shows maximum activity at both 65°C and 70°C instead of only at 65°C in the crude extracts. The observations on the patterns of thermal inactivation of Ph-II at both acid and alkaline pH are exactly similar to those obtained for acid phosphatase of the crude enzyme preparation. This observation may lead to a suggestion that the stability of acid phosphatase is not affected by purification, if Ph-II is primarily an acid phosphatase.

The conclusion that both acid and alkaline pH activities of Phosphatase-II of *T. vulgaris* are due to a single enzyme molecule (without being affected by any other

species), has been suggested by the following observations :

1. The magni tude of difference between acid and alkaline pH activities of Ph-II is the same, i. e., the specific activity at acid pH (6.0) is 4-5 fold higher than that at alkaline pH (9.5) at all the temperatures tried.
2. The thermal inactivation patterns are exactly similar at both acid and alkaline pH.
3. Electrophoretic mobilities of both the pH activity bands are the same under all the conditions tried.
4. Both acid and alkaline pH activities of Ph-II are copurified.

The conclusion that Ph-II is a classical and the only nonspecific acid phosphatase in *T. vulgaris*, can be drawn on the basis of the following evidences :

1. In the acidic range, both partially purified Ph-II and the acid phosphatase in the crude extract are found to be optimally active at the same pH (pH 6.0).
2. The temperature optimum (65-70°C) of Ph-II is more or less similar to that (65°C) of the acid phosphatase of the crude preparation.
3. After electrophoresis on polyacrylamide gels, only Ph-II gives the activity bands at acidic pH.
4. In the presence of Mg^{2+}, the thermal inactivation patterns of both Ph-II and the acid phosphatase of crude preparation are same at all the temperatures (50, 70 and 90°C) tried.

The delegate's findings concerning the above purification: scheme of phosphatase from *T. vulgaris* tempted the scientists in the field to look for the methods for improving further the yield of the purified enzyme especially for hydrolytic enzymes from actinomycetes. The biodegradation of the nonconventional substrates by the enzymes from actinomycetes suggests the tremendous role in terms of their biotechnological potential for getting the useful products such as vitamins, ethanol, antibiotics. hormons and other simple substrates for carrying out various industrialised enzymatic processes.

In one of the sessions (where the delegate was a chairperson also), much emphasis was given to membrane function with respect to their role in the active transport of metabolites across them. In that session, delegate's another research paper entitle "*In vivo* Effects of Ca^{2+} on Membrane-ATPase of an Obligate Thermophile-*Thermoactinomyces vulgaris* under Shake Culture Conditions" was presented and it was concluded that there appears to be a calmodulin-like membrane associated protein in *Thermoactinomyce vulgaris*.

In the end of the symposium, it was recommended that the areas of the biology of actinomycetes should be covered in seven sessions instead of nine sessions to make it more meaningful. Therefore, the scientific subjects to be covered under the

"VII International Symposium on the Biology of Actinomycetes" to be held in Tokyo, Japan in 1988, are as follows :

1. Genetics and Gene-Cloning System
2. Industrial Processes: Strain Improvement and Fermentatin
3. Screening of New Products
4. Systemetics and Ecology
5. Morphology and Cytology
6. Physiology and Biochemistry
7. Medical Aspects

The names of the President and the General Secretary for the "International Symposium on the Biology of Actinomycetes" to be held in 1988 (ISBA-88) in Japan were also announced by the International Organizing Committee. Professor Y Okami, Institute of Microbial Chemistry, Tokyo was appointed as the President and Dr M Okanishi, National Institute of Health, Tokyo as General Secretary.

INTERNATIONAL CONFERENCE ON THE APPLICATION OF FLUORESCENCE IN BIOMEDICAL SCIENCES : A REPORT*

Dr Pradeep Kumar attended the International Conference on the Application of the Fluorescence in Biomedical Sciences in Pittsburgh, Pennsylvania, USA from April 12-15, 1985. This conference was convened by the Centre for Fluorescene Research in Biomedical Sciences, Carnegie Mellon University, Pittsburgh, USA. In order to study the different cellular and molecular reactions of a living system and to simplify the complex methods and techniques of physical and chemical analysis, the fluorescence methods were introduced. It became essential to clarify the use of different fluorescent methods, their fluorochromes, instruments and their improvements for further simplification and accuracy. Due to the wide scale use of fluorescence techniques in the field of Science and Biomedical Sciences it became necessary to gather and focus on recent developments in fluorescence research and Instrumentation, that promises to significantly improve the utility of this branch of science.

The various aspects of fluorescent technology viz (i) Probe Chemistry (ii) Solution spectroscopy (iii) quantitative Fluorescence microscopy (iv) Digital image processing and (v) Flow cytometry and their application in biomedical sciences. Nine sessions, of which six for platform speakers and three for poster presentation constituted major divisions of the conference. During the conference scientists from different streams—biophysics, chemistry microbiology, immunology and genetics gathared and displayed the valuable informations about the applications of fluorescence in these fields. The topics discussed in the conference have covered almost each and every field of biosciences and biomedical Sciences.

Work presented during the conference by the participants had covered five main aspects of this field.

(i) New fluorescence techniques

(ii) Introduction of new dyes and their improvement

(iii) Development of new instruments

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* Based on the delegation report of Dr Pradeep Kumar, Department of Microbiology, Vallabhbhai Patel Chest Institute, University of Delhi, Delhi - 110007.

(iv) Use of laser rays in fluorescence research

(v) Three dimensional imaging and microscopy.

Under the above headings the work presented is of lasting valve in the field of Biomedical Sciences. Techniques described during the conference will also provide valuable informations for further advancement of the fluorescent studies which find their application in the following research fields :

1. Hormones (J A Katzenellenbogen et al)
2. Cell surface antigens and their kinetics (Dennis E Koppal et al)
3. Growth factors (J Schlessinger et al)
4. Cell surface events in immunology (W Watt et al)
5. Characterisation of cell populations in tumors by multiparameter flow cytometry (R F Murphy et al)
6. Lymphocyte function by physiologic probes (Thomas M chused et al)
7. Membrane potential changes in central nervous system (L Cohen et al)
8. Flow cytometric analysis of chromosomes for measuring genetic damange and use of antibody reagents and fluorescent hybridization for improved chromosome discriminatian (Joe W Gray).

Futher applications of these techniques can be expected to simplify our understanding of cancer immunology, membrane biology, Hormone chemistry, molecular immunology, and Fluorescence histochemistry. Fluorescence is being increasingly applied in most of the fields of research. New major developments are possible after such an outstanding conference.

The delegate presented his research work in the field of enzyme research. Fluoroscence is increasingly applied in the field of basic and applied research. Developments of new techniques have made this possibbe, such as the development of fluorescence histochemical technique. The new technique utilized a highly fluorescent substance 4-methyl-7-hydroxy coumarin for the histochemical localization of microphage hydrolases, mamely L-arabinosidase D-mannosidase and sulphatase-C.

The technique described here is extremely sensitive and provides valuable tool for histochemical enzyme localization. During the presentation the points raised by various eminent participants were clarified as follows :

(i) Use of fixatives for making macrophage monolayers before stining.

Both glutaraldehyde fixed and unfixed monolayers have been tried in our experiments, and positive results were obtained only with unfixed cells. In this approach the glass adherance property of macrophages was exploited, to avoid fixation to preserve maximum enzyme activity and in vivo status of these cells.

(ii) Appearence of nonspecific or autofluorescence.

In this technique the smears after incubation were subjected to washing with highly alkaline carbonate bicarbonate buffer (pH 10.2-10.4) for 2-3 seconds followed by two washing of 5 minutes each with PBS (pH 7.2) removes all the nonspecific fluorescence. No autofluorescence was observed with controls.

(iii) Similarity of the color of the reaction product for all the three enzymes.

The substrats used for each enzyme is specific but the fluorescent probes which are released after enzymatic hydrolysis are same, that is 4-methyl umbelliferone, hence, the color of the reaction product will remain same for all the three enzymes.

INTERNATIONAL SYMPOSIUM ON GEOCHEMISTRY AND HEALTH AND EUROPEAN CONFERENCE OF SOCIETY OF ENVIRONMENTAL GEOCHEMISTRY AND HEALTH : A REPORT*

Dr K A V R Krishnamachari visited visited UK under INSA-Royal Society, London Exchange Programme to participate in the International Symposium on Geochemistry and Health (15-17 April, 1985) and European Conference of Society of Environmental Geochemistry and Health (18-19 April, 1985). The international symposium on Geochemistry and Health was held at the Royal Society, London. The delegate was the Chairman of the Session II which mainly dealt with maping of diseases in humans which may have relevance to environment.

The introductory sesson was chaired by Professor S H U Bowie, FRS. In his remarks Professor Bowie appealed to the scientists present to make efforts to create a situation of inter-departmental and inter-country efforts to collaborate on matters of mutual interest particularly in relation to health problems prevalent in different parts of the world which may have bearing on the geochemistry of the regions concerned. Professor Bowie emphasised the need for application of the latest techniques for geochemical mapping of different regions in the world to have an idea regarding the excesses and deficiencies of various traces and heavy metals in the soil. The diseases which are related to heavy metals and trace elements in man are caused by the entry or dificiency of these elements in the human body. They take a long time to establish clinically. However, it should be possible for delineating such diseases in view of their very specific characteristic features.

Professor Bowie mentioned that The Royal Society had established a Working Group with these objectives in 1979-81. Between this period 11 groups met and had discussed difficulties encountered in identifying the cause and relationship between human diseases and geochemical observations. He said that the first true international meeting of scientists concerned with geochemistry and health was this meeting. He summarised the objectives of the symposium as to develop techniques for geochemical mapping, to identify diseases related to geochemistry, to develop national and international

*Based on the delegation report of Dr K A V R Krishnamachari, Deputy Director, National Institute of Nutrition, Hyderabad - 500007.

programmes concerning to human health and geochemistry. He said that the developed countries should look upon the developing countries as the field areas to supply the necessary original information.

In the introductory papers, Dr Plant and Dr Iain Thornton presented the latest techniques available in the field of geochemical monitoring of the various regions in the world. Their talk was in special relevance to the situation prevalent in UK. Dr Plant presented the mathematical techniques used for geochemical mapping with parti cular emphasis on the work carried out in North-Eastern Scotland. The diseases having bearing on geochemistry, according to Dr Plant, included cancer of the large intestine and stomach, coli lithiasis, hepiatie cirrhosis, foetat abnormalities and thyroid diseases. She also referred to the Moray Buchan study area where studies are in progress in relation to the low, the medium and high uranium containing granites in relation to human health.

Dr Thornton discussed about Bovine hypocupraemia and selenium deficiency in sheep in relation to seleoium deficiency in surface soils. He emphasised the need to go into indepth studies in relation to geochemical hot spots. Lead and cadmiun in surface soils constituted the other two important areas having relevance to human situation. He also emphasised that there is a suspision that high prevelence of thyroid gland cancer in Norway may have geochemical bearing.

Mceal presented the observations made in United States on the regional geochemical mapping partcularly in relation to mercury, phosphorus and sodium. He also discussed about the Alask Mineral Resource Mapping Programme with particular emphasis on uranium and thorium.

Professor Maksimovic from Yugoslavia discussed in depth the possible interaction between the Balkan Endemic nephropathy and the distribution of heavy metals in the province particularly lead, zinc and copper. In 1982, Uglama University initiated an exploratory geochemistry in relation to these diseases.

Dr Brain Davies discussed about the soild inventories and base line surveys in Britain. In 1978 soil mapping in relation to manganese, copper and rubidium was commenced in Britain. In North-Eastern Wales soil mapping was done for lead and cadmium; 1000 profiles were analysed for several elements in the soil. In Scotland In Irelend attention was mainly paid towards lead. Surveys included analysis of samples obtained in the Wales at every 5 km distance and the median values for soil were used for official purpose. The ratio median surface soil divided by median sub-soil values usually ranged between 0.8 and 2.1.

The delegate presented the observations made in India on the distribution of the flourosis problem and its clinical manifestations in different regions in the couutry in relation to the type of fluoride bearing rocks. He also discussed at length the clinical

variability in fluorosis in relation to the geochemical variations and variations in the food habits. Fluorosis perhaps reflects one of the well established diseases having a great bearing on the geochemistry of the region. He also brought out that in several parts of the world newer manifestations of clinical fluorosis are appearing including in India, China, Tanzania and South Africa.

Dr Gardner discussed the cause specific mortality in England and its mapping. He traced the history of mapping of mortality related to cardiovascular diseases and cancer in England and Wales, He pointed out an observation which may be important that cancer of stomach was related to the ratio of zinc/copper in the soil of that region. This needs further confirmation.

Dr Pickle primarily presented the mapping of cancer mortaility in the United States. This computerised mapping involved 12 countries and cancer of trachea, bronchus and lung were mapped out. It was observed that east coast cancer mortality rate was higher compared to the west coast cancer mortality.

Dr Bolviken discussed about geochemical and epidemiological data on Scandinavia. The Noord Kelott project which encompassed geochemical, geophysical and geological mapping in relation to lung cancer was discussed. The probability figures calculated for lung cancer were high in relation to exposure, smoking and asbestos inhalation.

The present trends in environmental geochemistry research activities in italy was discussed by Dal' Aglio. He presented toxicological studies in relation to uranium. The trace elements in the soil and inland waters in Italy are low. There is a difference in the arsenic and mercury contents in the waters of thermal and cold springs. He emphasised the need for Inter-European country programmes.

Professor Comstock discussed about the relationship between blood pressure and high intake of sodium and magnesium and coronary heart diseases.

A detailed presentation of Keshan disease was given by Dr Guang-Lu Xu from China. This disease overlapped salenium deficient areas of China, particularly in the northern part of the country. In south, however, there is no overlapping between the disease and selenium dificient areas. A survey carried out in 1972 indicated that this joint disease was related to areas in which the soil, water and the grain was low in selenium content.

Besides the above speakers there were others from over 11 countries who presented the information available in their respective countries in relation to geochemistry and health. The objective of this meeting was to formulate and possibly establish inter-country collaborative efforts in understanding all problems which have geochemical relevance.

European conference of Society of Environmental Geochemistry and Health was held in the premises of the University of Aston, Bermingham. These meetings represent the European meetings of the Society for Environmental Geochemistry and Health. There were participants from more than 10 countries including India, There were discussions on the relationship between the quality of drinking water and human health. There is a paper by Dal' Aglio on the trace element content of Italian, Indian waters. Dr Page described how the cadmium from the environment makes its entry into the food chain. A detailed paper on the distribution of trace elements in the soils of Scotland with particular reference to the copper, molebdenum and cobalt was presented by Berro et al. There were some papers dealing with fundamental laboratory aspects of analytical procedures, capacity of the soil to act as a cation exchanger, bio-assay for assessing phytotoxicity and uptake by the plants of the trace elements etc. There was a detailed discussion on the animal health in relation to environment. The delegate presented a paper on the human health effects due to fluoride toxicity. There was a paper on selenium and prevalence of keshan disease and Kaschin Beck Ben in China. There were a few more papers on the environmental distribution of heavy metals and their possible health implications in relation to men and fauna.

By and large these meetings reviewed the latest available literature concerning the distribution of heavy metals and trace elements in nature and their possible implications in the causation of symptoms in human beings. Some of the established diseases indicate a definite cause and effect relationship while in the case of some more diseases experts who there is only speculation regarding the possible cause and effect. The consensus of the met at both the meetings was that a time has come to make efforts to set up interdisciplinary and intercountry and intercontinent investigation programmes aimed for understanding the human disease in relation to geochemical distribution of trace and heavy metals.

There are several diseases in the world whose clinical manifestations are known but the aetiology is yet unknown. There are evidences to suggest that these diseases with unknown aetiology have some relationship to trace elements and heavy metals. Efforts have to be made to identify the exact pathogenesis of these diseases in relation to the environmental distribution of heavy metals and trace elements.

Apart from attending the above conference, Dr Krishanamachari attended a meeting at The Royal Society which was chaired by Professor S H U Bowie, FRS and was attended by Iain Thornton, Colin F Mills, S P Arora, J A Plant, P G Clegg. The purpose of the meeting was to critically evaluate the report submitted by Mr F G Clegg, who had earlier visited India under the Exchange Programme with INSA. The discussions mainly aimed at arriving at some agreement as regards the areas of research in which future collaborative programmes between India and UK could be established with particular reference to Geochemistry and Health.

Dr Arora of India who is a veterinary scientist and Dr Krishnamachari who is a medical researeh scientist were consulted regarding the areas of ill-health in animals and man prevalent in different parts of India which may have relevance to geochemistry. The group agreed that apart from goitre which predominently due to iodine definciency and hence disease related to geochemistry, fluorosis in man is an area which has relevance to health and geochemistry. It was also agreed that in the area of fluorosis research collaborative efforts may be attempted between UK and India with an appropriate sanction from the agencies from both the countries. In the field of veterinary science, impact of environmental distribution of selenium in relation to health of the cattle was also discussed in addition to iodine deficiency and consequent goitre in cattle.

It was recommended that a special sub-committee be established under the aegies of The Royal Society which should look into the matter and a request was made that The Royal Society may take up further discussions in this matter with the appropriate agencies in India such as the INSA, The Indian Council of Medical Research and Indian Council of Agricultural Research, to have concrete collaborative programmes, if the programmes are agreeable to the governmental agencies concerned.

INTERNATIONAL CONFERENCE ON STOCHASTICITY AND TURBULENCE IN PLASMAS - A REPORT*

Aparna Basu attended the International Conference on Stochasticity and Turbulence in Plasmas at University of California, California, USA from 26-29 March, 1985. The material covered in the conference was subdivided into the following sections : (*a*) Clumps and Turbulence; (*b*) Magneto hydrodynamic turbulence I & II; (*c*) Non-linear dynamics I - III; (*d*) Novel methods and phenomena; (*e*) Fluctuations and turbulence; (*f*) Low Frequency Turbulence; (*g*) Turbulence and closures and (*h*) Strongly coupled and non-neutral plasmas. Typically, each section began with a review talk followed by presentations of recent work in the area with a total of thirty lectures. There were two poster sessions with about twenty papers. The conference closed with a round table discussion. However as only two of the panelists listed were present, only the highlights of the meeting were mentioned in the panel discussion. The contries represented in the Conference were Japan, USA, Brazil, China, Sweden, Germany, Italy and India. Some of the papers highlighted during the conference are abstracted below:

I. *Numerical Simulatton*

1. Subcritical MHD Turbulence (**R** E Waltz) : Numerical simulations of a simple model for ideal magnetohydrodynamic modes (high-*n* ballooning modes) have shown stationary turbulence and transport at values substantially below the critical required for linear instability. The phenomenon appears to be similar to subcritical turbulence in plane parallel pipe flow.

2. Noise-sustained structure, Intermittency, and the Ginzburg-Landau Equation (Robert J Deissler) : Solutions of the time-dependent generalized Ginzburg-Landau equation in the presence of low-level external noise are studied. The numerical solutions exhibit a selective spatial amplification of noise resulting in spatially growing waves. The waves in turn result in the formation of a dynamic structure .It is found that the microscopic noise plays an important role in the macroscopic dynamics of the system. For certain parameter values, the system exhibits intermittent turbulent behaviour in which the random nature of the external noise plays a crucial role.

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* Based on the delegation report of Aparna Basu, Physical Research Laboratory, Ahmedabad-380 009.

II. *Turbulance Theory*

1. Decimated Amplitude Equations in Turbulence Dynamics (R H Kraichaan) A scheme of decimation, or statistical interpolation, is developed for stochastic systems which exhibit dynamical and statistical symmetries among group of modes.

   The decimation scheme (DS) bridges among several kinds of attack on the turbulence problems moment hierarchy equations, renormalized perturbation theory (RPT), renormalization group methods, and direct modeling of large systems by systems with fewer modes. The DS does not appeal to perturbation theory, but in the limit of strong decimation it can be analyzed perturbatively. The direct interaction approximation and other RPT approximations may thereby be obtained from appropriate moment constraints. One feature of the DS is that invariance to random Galilean transformation, a severe problem in the RPT treatment of turbulence, can be directly assured by constraints which relate 3rd-and-4th-order moments.

III. *Nonlinear Dynamics*

1. Chaos in dissipative nonlinear dynamics (E Ott) : Chaos in dissipative maps along with the appearance of strange attractors is reviewed. Certain dynamical systems exhibit multiple attractors. The phase space is then divided into basins of attraction for these attractors. The boundry of these basins can be smooth or fractal. A practical consequence of fractal basin boundries is that it can lead to great difficulty in predicting to which attractor a system eventually goes. The boundaries can be locally connected or disconnected. The complex structure of these boundaries are emphasised through numerous examples.

IV. *Quantum Plasmas*

1. Transport coefficients for dense, high temperature plasmas—Statitical theory and comparison with experiment (S Ichimaru) : On the basis of the quantum-statistical formulation of the electronic transport, we calculate the electric and thermal conductivities of the plasmas in a wide range of densities and temperatures where it is essential to take into account the varied degrees of the electron degenceracy and the local-field corrections describing the strong Coulomb-coupling effects. The physical implications of the results are investigated through comparison with other theories and experiment. For utility in the practical applications, we derive the analytic formulas parametrizing the computed results accurately for the generalized Coulomb logarithum appearing in those conductivities.

Classical Field Theory of Plasmas (P Morrison) : A new idea in Hamiltonian mechanics was discussed by Philip Morrison. It involved the use of the generalized Poisson bracket as a tensor quantity. According to Morrison interesting consequences may be obtained if instead of studying Hamiltonian flows, a variational principle is used to extremize the quantity $I = H + C$ (where H is the Hamiltonian and C the sum of Casimir invariants of the system) along surfaces of constant Casimir.

The paper presented by the delegate at the conference determines the stationary turbulent electric field fluctuation spectrum excited by a current along the external magnetic field in a plasma. We have used the fluctuation-dissipation theorem, which relates the level of fluctuation to the dielectric response of the plasma. The dielectric response of the turbulent plasma is obtained in terms of renormalised particle orbits. This method has earlier yielded theoretical spectra for low frequency ion acoustic waves in qualilative agreement with a wide varity of spectra measured in space, in the laboratory, and those obtained from computer simulations. This method has not been extensively used to obtain theoretical spectra. It is perfectly general and can be used for any wave modes excited in a uniform, unbounded plasma. Knowledge of fluctuation spectra is important for the determination of the transport properties of the plasma.

These results depict the fluctuation energy in any wave k, propagating at an angle 0 to the direction of the current. The most frequently quoted theoretical results on the ion acoustic specta are those of Kadomtsev-Petviashvili, and more recently Silin, which describe only the angular distribution of the spectrum.

Some of the points discussed, criticism, suggestions for further work during the conference and later are briefly mentioned below. It was pointed out by Dr Bingham of Rutherford Laboratory, England, that this work goes farther than any theoretical work in this direction. Dr R N Sudan of Cornell University, suggested that since gradients are always present in a laboratory plasma, drift wave spectra would be more appropriate to obtain. However, such drift waves are normally shear stabilized and not turbulent. He also suggested that for strong turbulence, mode coupling could be of importance. Moreover, for typical tokamak plasmas, the ratio of the ion cyclotron to the ion plasma frequencies are much smaller. Dr D Tetrault of MIT indicated that the effect of 'clumps' could be much larger than the particle discreteness effects considered by the delegate's group. Dr Silin suggested that the above results would be applicable only for very high magnetic fields. It was generally felt that the spectrum must be calculated in a self consistent way. This work is now in progress.

Relevance of Stochasticity & Turbulence Studies in Plasma to Indian Research Work

Traditionally, the development of theoretical plasma physics has depended strongly on a perturbative approach. In this approach, the *linear* response of the plasma to a small disturbance about an eqilibrium configuration is studied. It was believed until recently that qualitatively correct results would be obtained near equilibrium by this method. In applying these results it must be borne in mind that equilibrium plasmas are more the exception that the rule.

The basic equations overning the plasma are non-linear. Recent investigations into the behaviour of the simple *non-linear* and *coupled* equations have shown a remarkable complexity in their solutions, not apparent from the corresponding solutions of the linearised equations. Even with a few degrees of freedom, their behaviour mimics stochastic or random systems with many degree of freedom. Earlier it was believed that these stochastic fluctuations would influence the plasma behaviour only after they had been excited by a linear instability and grown to sufficient amplitude. This belief has been belied by experiments and numerical simulations reported at this conference, which shown that the fluctuations singificantly affect plasma behaviour even before the linear instability threshold has been crossed. One may conclude that the study of stochastic fluctuations which was thought to be important only, turbulent plasma must also be important for plasmas near equlibrium.

What relevance does this have on plasma research in India ?. This question can be asked with reference to theoretical as well as experimental research. There are clear indications that rather than examine phenomena in the light of existing theory using outmoded mathematical tools, the time is ripe for modifying basic plasma theory to incorporate the newer ideas of renormalisation, fluctuation theory, chaos, strange attractors etc. in order to achieve a significant breakthrough. It may be recalled that fluctuation theory has had important successes in the understanding of collective behaviour in many body systems, botably in the area of phase transitions. Plasma physics research has been stepped up in India in recent years, both in the theoretical and experimental areas. In spite of this increased effort, very little work is being done for example in fluctuations. It is important at this juncture that new pointers in theory, brought out in this and other such conferences, be rapidly assimilated not only for clearer understanding, by so that the impact on our experimental research does not lag behind.

SHORT COMMUNICATIONS

Professor P R ADIGA, Department of Biochemistry, Indian Institute of Science, Bangalore attended the INTERNATIONAL MEETING ON PREGNANCY PROTEINS AT COPENHAGEN, Denmark held during April 22-24, 1985 under the auspices of the Royal Veterinary and Agricultural University and organized by Professor Jann Hau of Department of Pathology.

The main purpose of the meeting was to provide a forum to examine the present status and future trends in research on pregnancy proteins in humans and animals, a topic of significant importance in the areas of human and animal reproduction, maternal and child health, prenatal diagnosis of genetic abnormalities and population control. The meeting also examined the potential physiological functions of these proteins as well as their biological and clinical applicability. The meeting started on Monday April 22, with the participation of over 80 delegates from all over the globe (India, USA, UK, France, Denmark, Sweden, FRG, GDR, Austria Australia, Norway, Hungary, Holland, Canada); the delegate was the only one invited from India. Following inauguration by Dean Rasmussen of the University, there were 12 scientific sessions during which a large number of original papers and short reviews on the current state of knowledge on classification, physiological functions and use in clinical diagnosis of abnormal pregnancies, of various pregnancy proteins were presented. These sessions dealt with biological functions of pregnancy proteins, clinical usefulness, changes in normal serum proteins in the mother during pregnancy, species difference in endocrine properties-early pregnancy factor, immunosuppression during early pregnancy, structural difference in macroglobulins in the pregnant and non-pregnant state; species specificity of pregnancy associated α_2-glycoprotein and alkaline phosphatase; prenatal detection of human malformation by different markers; immunological cross reaction between pregnancy proteins in different species, pregnancy proteins and acute phase reaction; comparison of pregnancy proteins in different species; female associated pregnancy proteins as cancer markers and pregnancy diagnosis in farm animals using pregnancy proteins. This was followed by a roundtable discussion on endometrial and decidual proteins and the need to classify them on the basis of their immunological and molecular properties. About 54 papers were presented at the meeting by various participants.

The delegate presented his researches on the discovery, isolation and characterization, evolutionary (from chickens to humans) and biological significance in terms of

fetal survival (and hence proper progression of pregnancy) of the two vitamin carrier proteins viz., riboflavin carrier protein and thiamin carrier protein. Implications of these novel findings in terms of immunoreproduction, the maternal and child health and possible diagnostic value in terms of early detection of intrauterine growth retardation, genetic abnormalities were highlighted.

The delegate was invited by the well-known protein chemist Professor M Ottessen to spend 3-4 days at the Department of Protein Chemistry, Carlsberg Laboratory, Copenhagen to have scientific discussion and to acquaint with the modern methods of protein isolation and structure determination etc. He gave a seminar on his work on Vitamin Carrier Proteins and Embryonic Development at the Carlsberg Laboratories, which was well attended. The delegate also took this opportunity to visit Human Reproductive Biology Unit and Department of Obstestics and Gynecology, Karolinska Institute and Hospital at the invitation of Professors M Badgyman and E Dicfaulzy at Stockholm, Sweden; he had a detailed discussion with various scientists there on ongoing research and gave a lecture on "Vitamin Carrier Proteins and Embryonic Development"

DR M K MAHAJAN, Professor & Head, Department of Radiotherapy, Christian Medical College and Brown Memorial Hospital attended the THIRD INTERNATIONAL MEETING ON PROGRESS IN RADIO-ONCOLOGY held in Vienna (Austria) from 27 to 30 March 1985. More than 100 delegates from 33 countries participated in this conference. The theme topics of discussion of the conference were : Altered fractionation, Particle beam therapy, Radiosensitizers and Radio-protectors, Optimizing combinations of radiotherapy and other therapies including surgery and hyperthermia.

The conference was inaugurated on 28th March and was followed by an introductory lecture by Dr Skoropad of International Atomic Energy Agency, Vienna. He outlined the role of IAEA in setting up of radiotherapy services and supporting research investigators of actual trends of Radiotherapy both in the industralized and developing countries. He elaborated it's role in arranging various coordinated research programmes and research coordination meeting towards the resolution of the problem of progress in Radio-Oncology. It was followed by another introductory lecture by Professor Herman D Suit of Massachusetts General Hospital, Boston. The topic was to predict the response of tumour to radiation treatment. He emphasized the importance of value of Haemoglobin percentage in modifying the radiation response in addition to other metabolic indices.

Later, the scientific session started to discuss 'Altered Fractionation'. The topical paper was by Professor M M Elkind of Colorado. He described his experiments

to know the value of dose rate in the onset of late developing normal tissue damage. It was concluded that conventional low dose rates in brachytherapy and moderate dose rates in teletherapy are in the optional rangs. Various papers presented there after in this session impressed upon various clinical factors in dose delivery viz dose per fraction, acclerated and reduced fractionation and schedules and combination of brachytherapy and teletherapy. The delegates' presentation in this session regarding the study of late injury in weekly fractionated external therapy was taken quite critically. In the following panel discussion it was concluded that the observation of good tumour response at the cost of significantly increased late normal tissue actions, the reduced fractionation schedules can be used in advanced malignancies, to achieve better paliation and reduced hospital stay. The studies of acclerated fractionation have a promissing prospect and so proper case control randomized trials were recomended.

In the session on Radiation Modifiers, the basic principals of radiation response, its quantification and its modification with various drugs were discussed. The results of the use of hypoxyradiotherapy, dihydroquinolones, tinidazole, misonidazole and metronidazol and antimitotic drugs like CCNV were presented. There was the only session of Particulate beam therapy. The results of various clinical trials of the use of different particulate beams like Neutrons, Protons and Pions alone or in combination with low LET photons were presented.

On the last day of the conference, various optimizing combinations of radiotherapy and chemotherapy and later with surgery were presented. The delegate presented the combination of conservative surgery with post-operative radiation in valual cancer.

In the afternon, papers were presented on radiotherapy and hyperthermia. The problems in raising tissue temperature to the optimal range and maintaining thereafter were discussed. Various biochemical processes in operation, role of hyperglycaemia, glucase regulated proteins and heat shock proteins was discussed. Summarising the conference, Professor Fower of Gray Labs impressed upon the quantification of various biological indices in the prediction of radiation effect and tumour response presented in the conference, as an important development in the near past. It is hoped that in the next meeting various trials incorporating these developments will help in optimising the treatment plans with radiation therapy.

Since anaemia is one of the commnest accompaniment in our patients, the confirmed role of haemoglobin in modification of radiation response due to the inadequate oxygenation of tissue revealed in this conference is an important fact. In the altered fractionation schedules, which is one of the commenest platform, the radiotherapists in India engaged into reduced fractionation has an important role in

paliative therapy only. In curative therapy the role of multiple fractions a day might show good prospects as was evident by the early results shown. Prospective studies are being planned. In radiation modifiers the results shown in the use of dihydroquinolone by Hungarian group are worth observing. Since this drug is commonly used in our daily practice due to preveblance of tropical diseases like amoebiasis in our country, it needs a close and critical observation as well as work up.

The use of hyper thermia and radiation is being gradually evolved and understood. It needs to be taken up in our country because with the least cost both to the patients and the hospital better local results in the tumours of breast, head and neck and uterine cervix can be obtained.

DR VINOD KUMAR GAUR, Director, National Geophysical Research Institute attended the ASCA SEMINAR ON MITIQATION TECHNOLOGY OF EARTHQUAKE HAZARDS at Tsukuba Science City from February 26-March 1, 1985. The Association of Science Cooperation in Asia which has its secretariat in the Science & Technology Agency (STA) of Japan, organises an annual seminar every year on some important topics of common interest. This year, the ASCA chose the above topic with a view to bringing member countries together, towards strengthening national programmes on the development of mitiqation technology of earthquake hazards, through exposition of the programmes of member countries and exchange of ideas. The agenda included i) presentation of Country Reports followed by general discussions to identify important steps required to be taken in different countries to strengthen their national endeavour in this field, and ii) to consider effective means of accelerating this endeavour through mutual cooperation amongst the ASCA member countries Finally, a set of recommendations were hammered out at the discussion session for further necessary action by the ASCA secretariat, and member countries. The delegate, at the very outset, was elected General Co-Chairman for the entire seminar as well as Co-Chairman of two other sessions : a special session in which Professor Asada delivered a talk on 'Earthquake Prediction Research' followed by discussions, and the final session of general discussions.

Member countries invited to the seminar happen to be located along the western margin of the Circum Pacific and the eastern margin of the Alpine Himalayan seismic belts. In each of these countries, devastating earthquakes have occured in the past and development of mitigation technology of earthquake hazards is an important concern.

The most notable scientific programmes towards this goal have been developed by the Japanese scientists towards forecasting a major earthquake expected to occur in the near future in the Tokai region which has been identified as a seismic gap lying between the rupture zone of the 1923 Kanto earthquake and that of the 1944 earthquake further south of Tokai. This zone has been well demarcated by Japanese

scientists and continuously monitored by an impressive array of sensors on a real time basis to detect and analyse anomalous changes in about 10 different measurable physical quantities preparatory to an earthquake. An Earthquake Diagnosis Committee constituted by the Government is summoned wherever these variations exceed predetermined threshold levels, to consider whether an earthquake warning is warranted. In case it is, the information is conveyed to the Prime Minister who upon consultation of the cabinet would then issue a warning and set in motion short term preventive measures to mitigate hazards. The Japanese Government has enacted legislation entitled 'Large Scale Earthquake Counter Measures Act' to devise the various steps to be taken by the Administrative authorities. A copy of the outline of the Act is enclosed here-with (Annexure 1). Next to Japan the Chinese research programmes on the mitigation of earthquake hazards is the most extensive amongst ASCA countries. Chinese scientists have the distinction of having predicted a major earthquake that rocked Haicheng in 1975, on the basis of geophysical precursors. They however, failed to predict the Tangshen earthquake (M=7.8), the following year. China also has 6 regional telemetered networks of observatories. These are being connected together with 10 other basic stations, with the Centre for Analysis and Prediction at Beijing, under a project 'The Auto Transmission and Processing System of Natural Seismic Data'. Concommittantly, continuing research programmes to refine the theoretical basis and methodology of data analysis for abstracting true precursory signals is in progress.

The Indian effort, although considerably less intensive and sophisticated than the Japanese effort, is nonetheless founded on sound conceptual framework. This was indeed recognized at the seminar as an important element in the Indian earthquake prediction programme which spells out clear cut objectives based on valid hypothesis.

DR C P GUPTA, Professor, Mechanical and Industrial Engineering Department, University of Roorkee, Roorkee, UP attended the AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIR CONDITIONING ENGINEERS (ASHRAE) Winter Meeting 1985 at Chicago, USA from 27-30 January 1985. During the conference 6 technical sessions, 20 symposium sessions, 20 seminar sessions and 22 form discussions were held. Nearly 170 technical papers were presented by technologists from USA, Japan, West Germany, Belgium, Sweden, Denmark, England, Canada, India, Lebanon, etc. The following main topics were covered : Ice and chilled water storage systems; Residential heat exchangers; Nonazeotropic refrigerant mixture technology; Performance of heat pumps; Small combustion engine heat pump technology; Energy Savings with evaporative cooling; Energy savings with proper skylights and windows; Underground piping systems; Smoke/fire propogation in buildings; Heat transfer in building elements; Heat transfer during two-phase flow; Dynamic modeling of HVAC system; Humidity control in buildings; Solar energy and electric utilities and Energy management.

The delegate presented a paper entitled 'An Experimental Investigation of Forced-Convection Condensation during Annual Flow Inside a Horizontal Tube' was presented during the sixth technical session. This paper reports new experimental data for evaluating the heat transfer coefficient during condensation of refrigerants R-12 and R-22 inside a horizontal tube. This data, along with previously published data have been used to evaluate the validity of three most widely cited correlations for calculating the heat transfer coefficient-those of Akers and Rosson, Azer *et al*, and Traviss *et al.* The first named correlation was found to be the best. New correlations, representing a certain simplification of Akers and Rosson correlations have been proposed. The results are belived to be of considerable value to condense designers. Some of the major results which are report in the confercnce are :

a) Use of ice and chilled water storage to save energy consumption in sarconditioning; b) Small combustion engine heat pump technology developments. c) Schemes for dynamic modelling of HVAC systems. d) Heat transfer coefficients during condensation of refrigerants.

Possible impact of the conference on Indian Research Work :

1) Several papers on the use of ice storage and chilled water storage to save energy consumption in airconditioning applications were presented. The cooling load varies with time. However, air-conditioning systems are usually designed keeping in view the peak load. Considerable energy saving can be accomplished by designing the system for lower than peak load, diverting excess cooling capacity during low load periods to ice or chilled water storage, and then drawing from this storag capacity during peak load periods. The above work is of considerable importance to our country.

2. Considerable saving in electric power consumption is possible by proper layout of skylights and windows.

3. A very large number of drinking water coolers are used in every country. However, the performance of these coolers is seldom monitored. By measuring the electric power consumption of the water coolers and bringing about better performance by design improvements, substantial energy savings may be obtained.

4. Important developments in small combustion engine driven heat pumps were reported. It would be useful if research in this area is conducted in India.

5. Papers dealing with dynamic modelling of HVAC systems were of considerable interest.

6. Data on heat transfer coefficients during condensation of refrigerant-oil mixtures was reported for the first time.

7. Research work reported on nonazeotropic refrigerant mixture technology would be of interest to scientists in India. Work in this area has been done at IIT, Delhi and IIT, Bombay. Use of such mixtures can bring about savings in energy comsumption.

DR A S N MURTHY, Department of Chemistry, Indian Institute of Technology, New Delhi visited UK under the INSA-Royal Society, London Exchange Programme from September 23-October 12, 1985. The following institutes were visited by him :

I. Department of Physical Chemistry, University of Cambridge, Lensfield Road, Cambridge (Host : Dr M D Archer)

a) Dr Archer's research activities include Photogalvanic Cells for Solar energy conversion, electrochemistry of Porphyrin-Quinone systems, electrochemistry of Glassy alloys and studies on Corrosion. Dr Archer showed the various experimental techniques relevant to the study of Glassy State and Corrosion and the electrochemical techniques employed to study the prophyrin-Quinone Systems. One of the important techniques frequently employed by her group is the rotating disc electrode assembly. The rotating disc electrochemistry is of great importance in understanding the thermodynamic and kinetic factors affecting electrode stability and obtaining kinetic information on various redox processes. Dr Archer is also involved in writing a book on Photochemical Energy Conversion, the details of which were also discussed and the delegete was asked to critically go through the contents of the chapter on Photogalvanic Cells. He described to the Group the delagate's work on photoelectrochemistry of systems containing several thiazene dyes and a series of reversible and irreversible reducing agents. In a typical photogalvanic cell the dye undergoes excitation to a triplet level upon illumination, induces a reaction in presence of a reducing agent to yield high energy products which lose energy electrochemically. The experimental techniques along with the trends in cell characteristics such as open circuit photopotential, short circuit current and efficiency of the cells were described. The factors which limit the efficiency were identified and the steps taken to minimize such limitations were discussed. The most important of them is the modification of electrode surface by a conducting polymer, polyprrole. Such an electrode is selective to one of the redox couples thereby making the electrode response better and consequently improves the performance of the cell.

The results on the photoelectrochemistry of semiconductor-electrolyte junctions were also presented with special reference to problems of photocorrosion. The preparation of polycrystalline thin films of n-CdS, n-CdSe, n-CdTe and N-$CuInSe_2$ by chemical bath and electrodeposition techniques was also discussed. The performance of thin film-electrolyte cells *vis a vis* single crystal-electrolyte cells was discussed.

Since rotating disc electrochemistry is vital to understand the stability of either the semiconductor or the different redox couples, the future plans for installing such a set up at IIT Delhi were presented. An experiment on the $K_4Fe(CN)_6/K_3Fe(CN)_6$

system by the rotating disc electrode assembly present in Dr Archer's laboratory was also carried out.

II. Inorganic Chemistry Laboratory, University of Oxford, South Parks Road, Oxford (Host : Dr H Allen O Hill)

a) Dr Allen Hill's research interests include mediated electrochemistry of proteins and the development of enzyme electrodes. Dr Hill explained the difficulties involved in the direct electrochemistry of proteins such as cytochrome C (positively charged), sulfur proteins and the 'blue' copper protein plastocyanin (negatively charged). The cyclic voltammograms representing the redox behaviour of the proteins are not obtainable with conventional electrodes. The situation dramatically improves when na electrode such as gold is modified by surface coating with an organic substance e. g. bipyridyl, stable cyclic voltammograms were obtained. The use of 'edge' graphite electrode also gives reproducible voltammograms. Similarly, the electrochemistry of negatively charged proteins (e.g. plastocyanin) was made possible through mediators such as Mg^{2+} and $Cr(NJ_3)_6^{3+}$. Dr Hill also described the attempts to design a biosensor for the determination of blood sugar. Dr F A Armstrong described his work on cytochrome C and on the negatively charged Fe-S protein and plastocyanin. The pyrolytic graphite edge modified with $Cr(NJ_3)_6^{3+}$ binds the 'blue' coppor protein plastocyanin reversibly, promoting persistent and well behaved direct electrochemistry. Dr NJ Walton described his detailed studies on the modifications of gold electrode with several series of bipyridyl compounds and the resulting electrochemistry cytochrome-C. Mr D Page showed the experimental details in obtaining cyclic voltammograms of cytochrome C with gold electrode modified with bipyridyl. Dr David Whitford highlighted the pleasures and pains involved in the preparation and purification of proteins employed for the electrochemical study.

III. Department of Chemistry, Imperial College of Science and Technology, London (Host : Professor W J Albery),

Professor Albery's current research interest is in the application of new electrochemical techniques to the fields of Medicine and Biology. He briefly touched upon the development of sensor electrodes for N_2O and CO_2. A second type of electrode uses a ring-disc electrode to carry out the microtitration of proteins with electrogenerated bromine. The development of modified electrodes for enzyme electrochemistry has also been described.

One of the senior research workers, Dr Wilde discussed about his work on the rotating disc electrochemistry of colloidal CdS in presence of an electrolyte in dark and under the influence of pulses of light. Flash photolysis studies have also been described. Mr Parsons described about his results on TiO_2 colloidal semiconductor. Mr C C Jones showed on how electrochemical ESR spectroscopy can be used to study redical

species in the coats of modified electrodes. Their results on polypyrole coated electrode have shown that it is a true organic conductor with a well defined band structure. Finally, Mr Craston described his interesting results on enzyme electrochemistry with an electrode coated with tetrathiafulvelene-tetracyanoquinodimethane charge transfer complex. It is interesting to see the excellent workshop facilities attached to Prof Albery's research group. Prof Albery, and a technican, Mr Pritchard are making potentiostats, galvanostats, rotating ring and disc electrode assembly systems and well jet ring disc electrodes and marketing them.

DR S RAMANA MURTHY, Department of Physics, Osmania University, Hyderabad participated in the INTERNATIONAL MAGNETICS CONFERENCE '85 at USA from 29 April to 2 May, 1985. The conference was sponsored by the Magnetics Society of the IEEE. There were 34 invited and 259 contributed talks covering the newest developments in all branches in magnetics. Approximately one third of the talks were devoted to recording with topics such as media, heads and systems were discussed. Other papers are described the newest developments in fields such as magnetic-optics, magnetic bubbles, permanent magnets, soft and amorphours magnetic materials, eddy currents, magnetic measurements power devices, magnetic separation, magnetic microwave devices. magnetic calculations and CAD. Papers on topics such as sensors, magnetocardiography and implantable devices are presented in a session devoted to magnetics in the life sciences.

The session on magnetic recording media was attended by over 300 people. There were ten papers in this session covering various topics in recording media. This session was delighted by Fujiwara (Toshiba R & D Centre) with a invited talk on Baferrite media for recording. Similarly the session on Microwave process, Materials and Devices began with an illuminating talk by Silber (U S Army Electronics Tech). There are nine papers in this session. The other sessions lske magnetic separation, Heads and domains, permanent magnets, thin film magnetic recording media, soft magnetic materials were began with a stimulating talks by Watson, O'Connor, Narasimhan, Futamoto and Wang respectively Other papers in these sessions were covered a wide range subject.

The plenary address was given by Dr Frank Mayadas, IBM Research Division, Vice President, Storage and 1/0 and Director of the San Joss Research Laboratory. His talk 'Computer Storage and its Evolution' was highlighted the events of INTERHAG'85. A one day tutorial on magnetic recording was also there in the conference. The education committee of the Magnetics Society was sponsored an evening tutorial entiled 'Domain Observations'.

PROFESSOR S MOHANTY, Institute of Medical Sciences, Banaras Hindu University, Varanasi visited Japan from 15-30 September 1985 as a vsiiting Scientist

under INSA-JSPS Exchange of Scientists Programme. Japan has made phenomenal progress in neurosciences since cecond world war and at present intensively involved in applied and basic research in neurosciences. The Department of Neurosurgery in the University Medical Schools are mostly taking a leadership role. He spent 8 days with Professor N Kaygeyama and his team of brilliant doctors and researchers at the Department of Neorosurgery, University of Nagoya Medical School, Nagoya. Dr Mohanty was fortunate enough to see large number of pituitary tumour cases admitted under Professor Kagayama for treatment. Vast majority of them were cushings disease with ACTH Secreting microadenomas of the pituitary. He along with Dr Kuwayama had operated over 150 cushings disease by transphenoidal approach, perhaps one of the world's largest series. Vast majority of the cases are worked up by endocrinologists and refered to him for treatment.

Interesting on going research on pituitary were cell culture, extraction of prolactin gene from prolactinomas, immunohistochemistry and effect of bromocriptine. There are many sub-specialities which have developed by younger scientists under guidance and support of professor Kagayama. There are brain oedeme and ICP groups, glioma group, cerebrovascular disease group. On-going projects in which Dr Mohanty held discussions were-Immunohistochemistry of rat pituitary gland (Dr Yamamoto); Measurement of free redical in dog brain with experimental spelepsy induced by intracerebral injection of $FeCl_2$ (Dr Kuchiwaki and Takada); Effect of Ca^{++} antagonist on experimental vasospasm in the dog (Dr Suzuki and Harats); Effect of hyperthermia on glioma cell line in vitro (Drs Kobayashi and Tanaka); Oeclusion of experimental ansurysm by detachable baloon (Dr Negoro and Terashima); Effect of chemotherapeutic agents on glioma cell line in vitro and analysis of cell kinetics by flow cytometry (Drs Yoshida and Ishiyama); Dynamics of catecholamine matobolites in nucleus raphe after intraventricular injection of morphine (Dr Kanamori); Effect of Ca^{++} antagonist on cerebral blood flow in the rat (Dr Suzuki); Preliminary experiment for measurement of blood flow by laser beam (Drs Kuchiwaki and Kinomoto); Prolactin mRNA in rat pituitary gland and human pituitary adenoma; Analysis by in situ hybridization and immunocytochemistry - (Drs Seo, Yamamoto and Sakurai). The research laboratories were extremely well cquiped and Professor Kageyama receives approximately Rs. 10,00000 annually for support of research. Professor Mohanty gave two talks-Experimental brain oedema—the role of SHT and Prognostic significance of plasma biogenic amines in head injury.

The delegate spent seven days in the Department of Neurological Surgery, University of Okayama Medical School. Professor Akire Nishimoto happens to be the Chairman and was the host. Like Nagoya, Professor Nishimoto's department was also very active in research – Hyperthermia treatment of gliomas, Intracranial pressure, Single photon emission scan for CVDS and AVMS, Central Control mechanism of pain, induction of experimental brain tumours by Rous Sarcomas Virus, and barbiturate coma for severely injured brain. The technique of cerebral revascularization in

Moya Moya disease (Nishimoto's disease) by EDAMS operation were learnt. The delegate gave talk on-'Experimental brain edema', 'Immune response in brain tumour patients' and 'Present states of Neurosurgery in India'.

Some of the important observations during the visit which could possibly be practised in India are —

1. Two years of original research done by residents in their 6 years of training period. Such background is useful to produce superior academic neurosurgeon and research workers.

2. All the staff members from Professor to clinical instructor or even some residents have had or year a two experience in best of centres in Europe and USA. On returning they mostly carry on the same work further with support from department and government. Ultimately they develop a subspeciality of the clinical and neurosciences.

3. Neurosurgery and neurosciences research is a prefered branch among fresh medical graduates of Japan.

4. Neurosurgery in Japan practically encompasses entire nervous diseases including medical neurology and clinical neurophysiology.

5. There are over 4000 neurosurgeons (over 2000 Japanese board certified) over 500 neurosurgical units and 5 scientific journal on clinical and basic neurosciences in Japan. Almost every unit has C.T. Scanner.

DR JAI RUP SINGH, Reader, Human Genetics Laboratory, Department of Biology, Guru Nanak Dev University, Amritsar attended the INTERNATIONAL MEETING ON GENETIC DIVERSITY AND ITS MAINTENANCE IN TROPICAL POPULATIONS at Frascati, Rome, Italy from 1-4 April, 1985. The conference was organized under the auspices of the International Association of Human Biologists and the University of Rome, Italy. The main aim of the congress was to review the type of work which has been undertaken or is being undertaken in the tropical populations formulate guidelines for future research in the tropical populations especially and on endeavours to be made during the current decade which has been declared as the decade of the tropicals. Several eminent human biologists including, Professor D F Roberts, Professor T Jenkins, Professor H Walter, Professor B Bonne-Tamir, Professor A Adam, Professor H G Schwarzacher from various parts of the world participated in the conference and its deliberations.

A paper entitled "Genetic Diversity of Cataract" was presented by the delegate. It dealt with the results of extensive genetic studies undertaken on over 500 cataract

patients and about 300 controls which had revealed the existence of the incidence of cataract is reported to be the highest. Various factors have been speculated for the persistence of such a high incldence of cataract in this region. The detailed genealogical, dermatoglyphic, biochemical and nutritional investigations revealed that in addition to the genetic heterogeneity of cataract, the environmental factors might also be operative. Fifty-six percent of the cases showed positive family histories. Out of these, in 82% vertical transmission was observed while in 18% the affliction was confined only amongst the sids. Palmer and finger dermatoglyphic variations studied in the cases exhibiting different genealogical patterna showed significantly increased frequency of A, L^r, W^c and reduced frequency of W^s in cataract ous patients while no difference was seen for the atd angles. The electrophoretic studies of the cataractous lenses revealed the presence of different banding patterns in nuclear, cortical and hypermature cases. The role of nutrition in the maintenance of this heterogeneity was also discussed.

It was agreed that a great deal of material is available on the tropical populations but still lot remains to be done. Therefore, it was decided to concentrate more work on the tropical populations during the present decade. In order to further organize the working and to provide guidelines and also to avoid duplications of research work, some persons were nominated to formulate the basic guidelines and then circulate these to the members. The members nominated were, e. g., Professor Schwarzacher (Cytogenetical studies), Dr McCann (Mitochondrial DNA studies), Dr Papiha (Biochemical studies), Professor Bonne Tamir (Population studies), etc. Professor Roberts is to act as the coordinator for these.

A good deal of work on the genetic markers and on the distribution of various genetic traits is being undertaken in India. Many of these studies are undertaken on the populations residing in the vast tropical areas of India. The general consensus reached at during the conference and the broad guidelines which are being worked out for undertaking more research work in this direction should be taken into consideration for future planning of the research work or even in the modifications for the currently undergoing research.

In addition to the Indian papers, a number of presentations, especially by Professor D F Roberts, Professor R L Kirk, Dr S S Papiha, Professor H Walter and Professor A H Bittles dealt with the data which had been collected from different tropical populations of India. This indicates a great deal of international interest in the tropical indian populations and also increased international cooperation in the study of genetic polymorphism in our populations. These also indicate the high degree of international standards reached by the Indian scientists, and their world wide acceptability.

The suggestions that more importance should be given to the study of chromosomal polymorphism, mitochondrial DNA, red cell enzymes, dermatoglyphics, and

population studies would be of benefit for the research work being undertaken. Regarding the eye disorders like cataract, the use of dematoglyphics for bringing out underlying heterogenesity was appreciated and was suggested that dermatoglyphics could be a powerful tool if utilized properly.

PROFESSOR R M SINGRU, Head, Department of Physics, Indian Institute of Technology, Kanpur, 208016 participated in the SAGAMORE VIII CONFERENCE ON CHARGE, SPIN AND MOMENTUM DENSITY (organized under the auspices of International Union of Crystallography) at Sanga Saby, Sweden from July 28-August 4, 1985. There were 11 review talks, 16 short oral and 50 poster presentations. There was also a panel discussion on chemical bonding. As the number of participants was relatively small (80) there was lot of scope for discussion after the talks and during the conference. A novel feature of the conference was that each poster session was preceeded by a 2-minute summary of the paper by each author and there was a group discussion about the posters after the poster session was concluded. Major breakthrough reported were (i) Use of density matrix theory in calculation of charge, spin and momentum density (V H Smith) (ii) Use of Wigner functions in theoretical calculations (W Weyrich) (iii) Development of x-ray Compton spectrometer (P Pattison and others) (iv) Applications of density functional theory to atoms, molecules and solids (U von Barth). Participants in the conference have recommended that an improved interaction between experimentalists and theoreticians on one hand and people working with different experimental techniques (X-ray diffraction, neutron diffraction, Compton scattering positron annihilation, electron scatering etc) on another hand is very necessary. A common feature in the charge, spin and momentum density is the wave function of electron and calculations of different densities using common wave functions should be carried out.

The delegate presented an oral talk (15 minutes) on "Electron Momentum Distribution in Vanadium" and a poster on "Effect of eg: t2g electron ratio on the fourier transform of momentum density in vanadium". Both these presentations were appreciated by other participants because the work showed how a systematic comparison between theory and experiment can be made by using different approaches and how one can reconstruct momentum distributions from experiment and test electronic wave functions used. The studies on reconstruction of momentum distribution was hailed as an important milestone in the interpretation of experimental data obtained by positron annihilation and Compton scattering and the delegates was asked to present a short talk on this during the panel discussion in the Conference.

In India there are various groups working in the experimental x-ray diffraction, neutron diffraction, Compton scattering, position annihilation etc and theoretical (solid state physics, band structure calculation of charge, spin and momentum density of electrons, theoretical quantum chemistry) areas covered by this conference.

Proceedings of the SAGAMORE VIII conference to be published in "Physica Scripta" can be very useful to these different groups in India and they can see how interactions between various experimental and theoretical sub areas are growing and how it can lead to a more complete understanding of electron wave functions in atoms, liquids and solids.

Recently Department of Science and Technology has started an exercise to bring together Indian physicists and chemists who are involved in the calculation of electron wave functions. It is proposed to hold a workshop in this area. Proceedings of the SAGAMORE VIII conference can held such groups in India to plan their future research activities.

DR BHAVDISH N JOHRI, Professor & Head, Department of Microbiology, G B Pant University of Agriculture & Technology Pantnagar visited France under INSA-French Academy of Sciences Programme. Three major research laboratories were visited at the Paul Sabatier University, Toulouse, France which included, Lab de Cryptogamie (Professor C Montant, Director), Centre de Physiologie, Vegetale (Professor Alain M Boudet, Director), and Centre for Microbial Technology, (Professor G Goma). The research interests at these laboratories include the following :

1. *Biology of Truffles* : These are the fruit bodies of *Tuber melanospermum* that are found 5-10 cm, below the ground level as ectomycorrhizae in soils all over the world. The major host plant genera are, *Cystus albidus*, *Coryllus*, *Helianthamum*, *Pinus*, *Populus* and *Quercus*. The fruit bodies are very fragrant and are considered a delicacy in France. There are several private individuals who grow these truffles in special nurseries on a pattern similar to mushrooms. They have tremendous food value in france and are sold at rates varying between 1500-2000 france per Kg.

Professor C Montant, Director, Lab de Cryptogamie is an expert in truffles and he is very keen in looking for these fungi in India and to develop a joint project with the delegate's laboratory. Dr Michel Kulifaj of this lab has done an extensive investigation on the Biology of *T. melanospermum* which includes an effort at artificial cultivation.

Fungal Lipids & Membraness

This is another major area of research interest of Lab de Cryptogamie and in which several aspects of lipid research and fine structure are being investigated. Both lower and higher fungi are being examined which include, *Hypomyces chlorinus*, *Scopulariopsis*, *Aspergillus ochraceus*, *Mucor mucedo*, *Trichoderma viride*, *Verticulluim alboatrum* and *Achlya bissxualis*. The major emphasis in this research is on the make-up lipid structure in fungal membranes as also on the presence of phospholipid transfer

proteins fungi. This lattter are important in explaining different temperature optims for growth in psychrotolerant, mesophilic and thermotolerant molds. Fatty acid unsaturation and lipid microviscotity of whole cells and of lipid exracts in being examined. A correlation has been noted between cold temperature acclimation and increased fatty acid unsaturation and lipid fluidity.

A study of *Hypomyces chlorinus* has shown that a dificiency of biotin does not change the nature of major components in walls although it does alter their proportion. The results have indicated occurrence of a peptide polysaccharide complex and a glucan which has essentially a beta configuration. Other questions that are being asked include:

I. Is the increase in polyunsaturated fatty acids in fungi cultured at cold temperature linked with:

   a) The physical state of the membrane lipids which is based on the assumption that increased desaturase activities at cold temperatures promote a high fluidity due to polyunsaturated fatty acids. Alternately, the change in fluidity at cold temperature promotes desaturase activity.

   b) Industion and synthesis of microsomal desaturase is triggered by cold temperature.

   c) Oxygen availability at cold temperature is responsible for the increased desaturase activity in the substrate vs enzyme rate relationship.

Investigations to check these possibilities are being carried with *Mucor mucedo* and *Aspergillus ochraceus* because both these mesophilic moulds are able to modify their unsaturated fatty acid synthesis at cold temperatures.

II. Membrance constituents from *Scopulariopsis brevicaulis* have been examined ultracytologically and biochemically. The ratio of protein to lipids has been found to be near 1 whereas neutral lipids are glycerides (di-and tri), free sterols and steriol esters; phospholipids are phosphatidyl-ethanolamine and phosphatidyl-choline.

Facilties for GLC, HPLC and mass spectrometry can be availed on campus as also EM. Other routine facilities also exist in the various labs although for enzyme work some minor componsents might have to be added. Professor Goma's lab has one of the finest facilties any where in the area of microbial technology with fermenters of various kind and other ancillary equipment.

   c) Collaborative research in the area of membrane structure/composition in thermophilic fungal systems as also in their enzymes and steroidal conversions can be developed fruitfully.

DR (MRS) VEENA CHOWDHURY participated in the INTERNATIONAL SYMPOSIUM POLYMER 85 held at Chisholm Institute of Technology, Canlified, Melbourne from 11-14 February, 1985. Polymer 85 was the first single topic International symposium sponsored by the International Union of Pure and Applied Chemistry (IUPAC) and Australian Academy of Science and was being organized by the Polymer Division of the Royal Australian Chemical Institute (RACI).

The present conference dealt with the several new aspects of polymer characterisation and analysis. Several review lectures as well as research papers on the degradation and stabilization of polymers were presented by the authors. The delegate also presented a paper entitled "Degradation and stabilisation of polyproplene". These lectures were quite informative. The major problem of polymers producers in India is how to stabilise the existing polymers for outdoor applications. The delegate also visited Royal Melbourne Institute of Technology for consulting Dr R Shanks. He is also working on the stabilisation of polymers. The Centre for Materials Science & Technology, IIT Delhi offers a teaching programme on Degradation and stabilisation of polymers. Thus the knowledge acquired by attending this symposium will be useful in teaching this course. This will increase the capabilties both in teaching and research.

There were several lectures delivered by authors on the use of polymers in solar collector etc. Thus the knowledge of stabilisation of the existing polymers will be useful in fabricating solar collectors as well as for using polymers in various outdoor applications.

More emphasis was given in this conference on the use of several instrumental techniques in the characterisation of polymers such as NMR, FTIR, mass spectrometry optical methods, x-ray and neutron techniques, chromatography and conformational analysis. The exhibition of books as well as of instruments was also quite interesting.

It has been said that the development of polymerisation is the greatest single contribution that chemistry has made to the world and the topic of Polymer 85-"Characterisation and analysis of polymers" provides the means to identify the result of polymerisation reactions and evaluate the properties of polymer materials. It should also be remembered that the use of polymers as materials is the main reason for the scientific and practical interest in them.

Polymer science is an interdisciplinary subject and this was clearly shown by the diversity of session in this symposium-rubbers, adhesives, biological polymers, polyelectrolytes, liquid crystalline polymers etc. All kinds of instrumental techniques are used to characterise polymers and are represented in the contributions to this symposium. The importance of NMR has been emphasized by the one day workshop being held immediately prior to the symposium.

Now a days, there is a need to develop advanced polymer composites or polymeric materials having optimum properties for structural applications, new photoresist technology in microelectronics, thermotropic liquid crystalline polymers for biomedical applications and to carry out the mechanistic studies on the degradation and stabilisation of polymers. Polymeric meterials are being used in outdoor applications where degradation may be initiated by various physical and chemical agencies. Now-a-days polymers are an attractive proposition for solar collectors due to their light weight, corrosion resistance, design flexibility and ease of processing. Hence there is a need to develop polymers with better retention of mechanical and optical properties in outdoor application. Several papers were presented in this field.

PROFESSOR K L CHOPRA, Indian Institute of Technology, New Delhi-110016, visited Hungary from September 20 to October, 5, 1985 under the INSA-HAS Inter-Academy Exchange programme, in response to the invitation of the Academician E. Nagy, Director, Research Institute of Technical Physics, Budapest. The following Institutes were visited :

a) Research Institute of Technical Physics-Visited Departments of Structural Studies and Semiconductor Physics, and gave a seminar on "Tailored Micromaterials".

b) Microelectronic Company (MEV)—Visited Thin/Thick Film Device Production Facility and gave a seminar on "Transparent Conductors".

c) Central Research Institutes for Physics-Visited Institutes of Solid State Physics and Microelectronics.

d) Vespren University-Visited Chemistry Department and Central Instruments Centre.

e) Geophysics Institute-Visited the Institute and the Eotvos Museum.

f) Institute of Electrical Industry-Visited the Silicon Solar Cell Production Laboratory and gave a seminar on "The Present Status of Photovoltaics".

g) Institute of Nuclear Physics, Debrecen-Visited the institute facilities, participated in the IUVSTA Executive Committee Meeting held in the Institute and presented a status report on Thin Films on behalf of the Thin Film Division of IUVSTA, Besides, discussions were held with some UNVSTA Executive Committee Members regarding the programme for the 7th International Conference on Thin Films held triennially to be organized by us in New Delhi on December 7, 1987. Some of the important technical observations worth mentioning are :

1. All institutes are well equipped with very modern and computerized facilities. A singular feature of the institutes is the commitment to develop some sophisticated

equipments both for the use of the Hungarian Institutes as well as for export wherever possible. Among the excellent examples is the computerized Deep Level Transient Spectrometer (DLTS) for analysis of traps/impurities in semiconductor devices developed by the Mechanical Physics Research Institute. It is just about the best instrument world-wise. It is being produced by an enterprise (discussed later) and several instruments have been exported to countries such as Japan and USA. The same institute has developed an ion etching unit capable of etching any material at phenomenal rates of 25 um/hr and is also being produced for export.

Perhaps the most impressive example is that of the Computer and Instrumentation Centre of the Central Research Institute which is producing 300 million dollar worth of minicomputers (which are compatible with IBM-PCs and PDP systems from both software and hardware points of views).

The nuclear Research Institute has developed facilities for producing UHV systems and Quadrupole mass spectrometers. Reasonably good Auger and ESCA systems for research have been fabricated by this Institute (as well as the Technical Physics Institute). It should be pointed out that the Tungstrom factory in Budapest provides considerable UHV technology support to such endeavours.

2) The research work in the areas of thin films, microelectronics and semiconconductor physics is of a high calibre. The research projects are of both academic and technological interest. The Hungarian Academy of Sciences (HAS) supports the R&D Institutes only partially (40 to 70% of the budget). The rest of the budget requirement is met from sponsored/industral research projects. Typical examples are the microstructural problems associated with the alignment of liquid crystals on obliquely deposited SiO_x films, stability of thin film michroms resistors, multilayered LPE deposited LED's, interface problems associated with-film display devices, development of new lasers e. g. He Kr, etc. On the whole, a professional interest and commitment in doing a good job of the R/D projects are noteworthy.

3) Besides the need to attract sponsored R&D projects to supplement the Institute budget, incentives to earn additional money to enhance salaries are provided in all R&D institutions by a governmental policy. Any group of individuals in an institute can set up an enterprise (a sort of private company approved, of course, by the head of the Institute) to manufacture a product/device/instrument on thg basis of know-how developed in the institute and by utilizing the facilities of the Institute in spare time and on nominal charges. In the Solid State Physics Institute of CRI, for example, more than half of the staff is engaged in such enterprises. The systems no doubt has its merits and demertis. But, it is successful in translating a loboratory work into a useful working product for both national and international sale. Among the several impressive examples in the laboratory scale two shift production of about 15% efficiency 3 inch diameter silicon solar cells of 10 KW/year capacity. The cells are incorporated into

stand-alone power yacks for a variety of applications in several East-European countries.

4) The microelectronic company (MEV) employs about 300 workers for production of such thin/thick film eevices as resistors, capacitors, A-D converters, image displays, sensors, etc. The company has very modern laboratory and production facilities, quite a few imported from USA and Japan. The company incorporates these devices into instruments/systems which are sold all over the world. Another part of HEV (which is not allowed to see) deals entirely with LSI/VLSI. The high investment of a small country in the high technology areas of microelectronics is indeed noteworthy.

Forthcoming Seminars/Symposia/Conferences etc.

IAVCEI/IUGG sponsored International Volcanological Congress at Auckland, New Zealand from February 1-9, 1986.

CODATA sponsored Workshop on Standardization of Environmental Data at Toronto, Canada in May 1986.

IUIS sponsored VI International Congress of Immunology at Toronto, Canada from July 6-8, 1986.

IUBS sponsored International Conference on Differentiation Patterns in Higher Plants at Zurich, Switzerland from July 13-18, 1986.

XXX International Conference of IUPS at Vancouver, Canada from July 13-19, 1986.

X International CODATA Conference at Ottawa, Canada from July 14-18, 1986.

XV General Assembly of CODATA at Ottawa, Canada from July 18-19, 1986.

IUPHAR sponsored Third World Congress of Clinical Pharmacology and Therapeutics at Stockholm, Sweden in July 1986.

IMU sponsored International Congress of Mathematics at Berkeley, USA from August 3-11, 1986.

IUBS sponsored III International Conference on Aerobiology at Base, Switzerland from August 6-9, 1986.

IUPAC sponsored VI International Pesticide Chemistry Congress at Ottawa, Canada from August 10-17, 1986.

IUGS sponsored IV Kimberlite Conference at Perth, Australia.

IUBS sponsored XXII International Horticultural Congress at Davis, USA, from August 11-20, 1986.

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